THE RESTORATION OF LAKE LASHAWAY

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Cover photograph: outlet control structure at the south end of Lake Lashaway, including the fenced catwalk, sluice gate valve, and outlet chamber. Photo credit: Robert Haynes.

SECTION 314 PHASE II RESTORATION PROJECT

OF

LAKE LASHAWAY

by

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Division of Water Pollution Control
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This Final Report is dedicated to Robert E. "Bob" Munyon, President of the Lake Lashaway Community Association from 1964 to 1990, who "coordinated and exhorted" tirelessly the participation of the towns, Community Association, and state and federal governments to restore Lake Lashaway.

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ABSTRACT

This final report is documentation of the Section 314 Phase II Restoration Project of Lake Lashaway, which is located in central Massachusetts within the corporate limits of East Brookfield and North Brookfield. This Lake was in a degraded condition in the 1970's due to loading of nutrients and sediments from its periphery and large watershed. By 1978 Cabomba caroliniana covered 68 of the 270 acre surface area, and Najas flexilis covered 33 acres of the littoral zone to a depth of 2 m. Repeated attempts to control these macrophytes chemically proved inadequate, so the two towns and the Lake Lashaway Community Association funded a eutrophication study to evaluate existing conditions. As part of the Section 314 Phase I Assistance Agreement, a shoreline sanitary survey (1980) and feasibility study (1981) were conducted to elucidate further the sources of nutrients and alternatives to restore the Lake. On February 4, 1981 the U.S. EPA approved the Phase II Assistance Agreement for a restoration project, one of the first in Massachusetts.

The major work elements of the Phase II project were design and construction of an outlet structure to facilitate lake drawdown, and construction of a retention dam on the inflowing Fivemile River to protect upstream wetlands during drawdown. Greenman-Pedersen Associates of Worcester, Massachusetts provided final design plans and project management for the outlet structure, which was constructed by Marois Brothers, also of Worcester. Construction began on September 1, 1982 and the sluice gate valve was opened ceremoniously eighty days later to initiate the first drawdown. A complete 2.4 m (8 ft.) drawdown was postponed until the winter of 1984-85 pending construction of the retention dam by David A. Robinson Contracting of Barre, Massachusetts in December 1983. Total expenditure of funds to complete the Phase II project was $298,400.62; the federal contribution was $149,200.31. The 50% non-federal match was derived from both state and local (East Brookfield and North Brookfield) funds.

The widespread occurrence of nuisance macrophytes in Lake Lashaway was terminated following completion of the Phase II project. Prior to construction of the outlet structure in 1982 macrophytes covered 70% of the Lake, but the effect of subsequent winter drawdowns was dramatic and unequivocal. As expected, C. caroliniana was decimated since its growing season is too short for seed production at the latitude of Lake Lashaway, but the corresponding decline of the seed-producing N. flexilis is in contrast to published literature. Diminished frequency of occurrence was also recorded for populations of Pontederia cordata, Gratiola sp., Myriophyllum sp., Sagittaria latifolia, Sparganium sp., and Myosotis sp. Seven other macrophyte populations were no longer observed during plant surveys following repeated drawdowns. No increased frequency of occurrence was recorded for macrophytes subsequent to drawdown with the possible exception of Potamogeton bicupulatus.

A seven year monitoring program conducted by the Massachusetts Division of Water Pollution Control from August 4, 1982 (prior to construction) to August 9, 1989 revealed that there were no violations of Massachusetts Surface Water Quality Standards. This included periods during construction of the outlet structure, dredging of the north cove area (a separate state-local project), and seven sequential winter drawdowns. Although more than half of the pH values measured at the outlet fell below the standard range (pH 6.5 - 8.0), it was not a

consequence of construction or drawdown. The low pH of water flowing out of Lake Lashaway simply reflects the hydrogen ion activity of inflowing water.

There is practically no evidence from the monitoring data that excess suspended solids were discharged from Lake Lashaway to the East Brookfield River as a consequence of Phase II construction or annual drawdowns. Similarly, annual drawdowns have not contributed an additional burden of nutrients to the East Brookfield River and downstream water resources. The concentrations of total phosphorus and nitrate nitrogen in outflowing water were remarkably similar to those of water flowing into Lake Lashaway. Ammonia nitrogen concentrations were more variable, but they exhibited the same relationship between these two sampling stations.

The restoration of Lake Lashaway has facilitated a resurgence of recreation and shoreline management activities. A new beach was established in 1985 by the two towns, a permanent boat ramp was built by the Lake Lashaway Community Association in 1987, the Sail Club now sponsors races every Sunday, the Ski Club has reformed and a new course has been established on the Lake, and the Massachusetts Bass Fishing Club has placed Lake Lashaway back on its regular circuit for tournaments.

The Section 314 Phase II project at Lake Lashaway is considered to be an unqualified success by the Commonwealth's Department of Environmental Protection, East Brookfield and North Brookfield Boards of Selectmen, and Lake Lashaway Community Association. Lake Lashaway is once again near its full potential for aesthetic and recreational enjoyment by the public.

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INTRODUCTION

This final report is documentation of the Section 314 Phase II project on Lake Lashaway, the first restoration project in Massachusetts funded under the Clean Water Act (Public Law 95-217). It also includes a discussion of certain events antecedent to award of the Phase II grant since a number of action steps were taken prior to promulgation of Section 314 regulations, which involved local, state (DEQE, DWPC), and federal (U.S. EPA) personnel. A detailed twelve year chronological narrative of major steps/events covering the history of the Lake Lashaway restoration project is presented in Appendix I.

Lake Lashaway and its watershed are located in central Massachusetts. The lake is included within the corporate limits of East Brookfield and North Brookfield, whereas the watershed extends northward into portions of Spencer, New Braintree, Oakham, and the extreme west border of Rutland (Figures 1 and 2). The Fivemile River drains the watershed and discharges into the north end of the lake. Since the watershed area is comparatively large (24.6 square miles), as is the watershed area to lake area ratio (58.5:1), approximately 13 lake volumes per year are flushed through Lake Lashaway. Water exiting at the south end of the lake forms the East Brookfield River (Figure 1).

Lake Lashaway was in a degraded state in the 1970's due to loading of nutrients and suspended sediments from its large watershed. According to Lycott (1979), deposition of suspended sediments reduced depth to less than 1.5 meters (5 ft.) in several areas of the lake by 1978 (Fig. 3). At that time, the average depth was 2.6 meters (8.5 ft.); its maximum depth was about 5.5 meters (18 ft.). In addition to loss of lake volume, loading of sediments and nutrients accelerated the growth of macrophyte populations that inundated over 40% of Lake Lashaway (Lycott, 1979). The dominant nuisance plants were Cabomba caroliniana Gray (Fig. 4), or fanwort, and the bushy pondweed, Najas flexilis (Willd.) Rostk. and Schmidt (Fig. 5).

The public pursuit of recreation at Lake Lashaway was extensive prior to its degradation. Sailboats were a common sight, and there were organized races every Sunday involving 30 to 40 class boats. Water-skiers tethered to motorboats constantly plied the lake surface, as did canoeists, but usually not at the same time. Floats and docks lined the Lake's periphery, where more than two-hundred families swam and fished. Non-resident fishermen were plentiful too. Camp Atwater provided swimming and boating recreation for disadvantaged children, and North Brookfield used the Camp's beach for swimming classes.

The extensive mass of nusiance vegetation interfered with virtually all of the aforementioned activities, and it diminished considerably the aesthetic appeal of the lake as well. Lakeside homeowners resorted to dragging old bed springs along the shoreline to remove the tangled mass of vegetation. Furthermore, it was nearly impossible to access the Lake from the undeveloped boat ramp at the north cove due to the accumulation of sediments and dense beds of macrophytes.

Aesthetic and recreational activities were so diminished by 1978 that the towns of East Brookfield and North Brookfield executed a contract with Lycott Environmental Research Company of Sturbridge, Massachusetts to undertake a eutrophication study of Lake Lashaway. The study was completed in two phases, separately funded, and a Comprehensive Eutrophication Study of Lake Lashaway

Figure 1

LAKE LASHAWAY WATERSHED

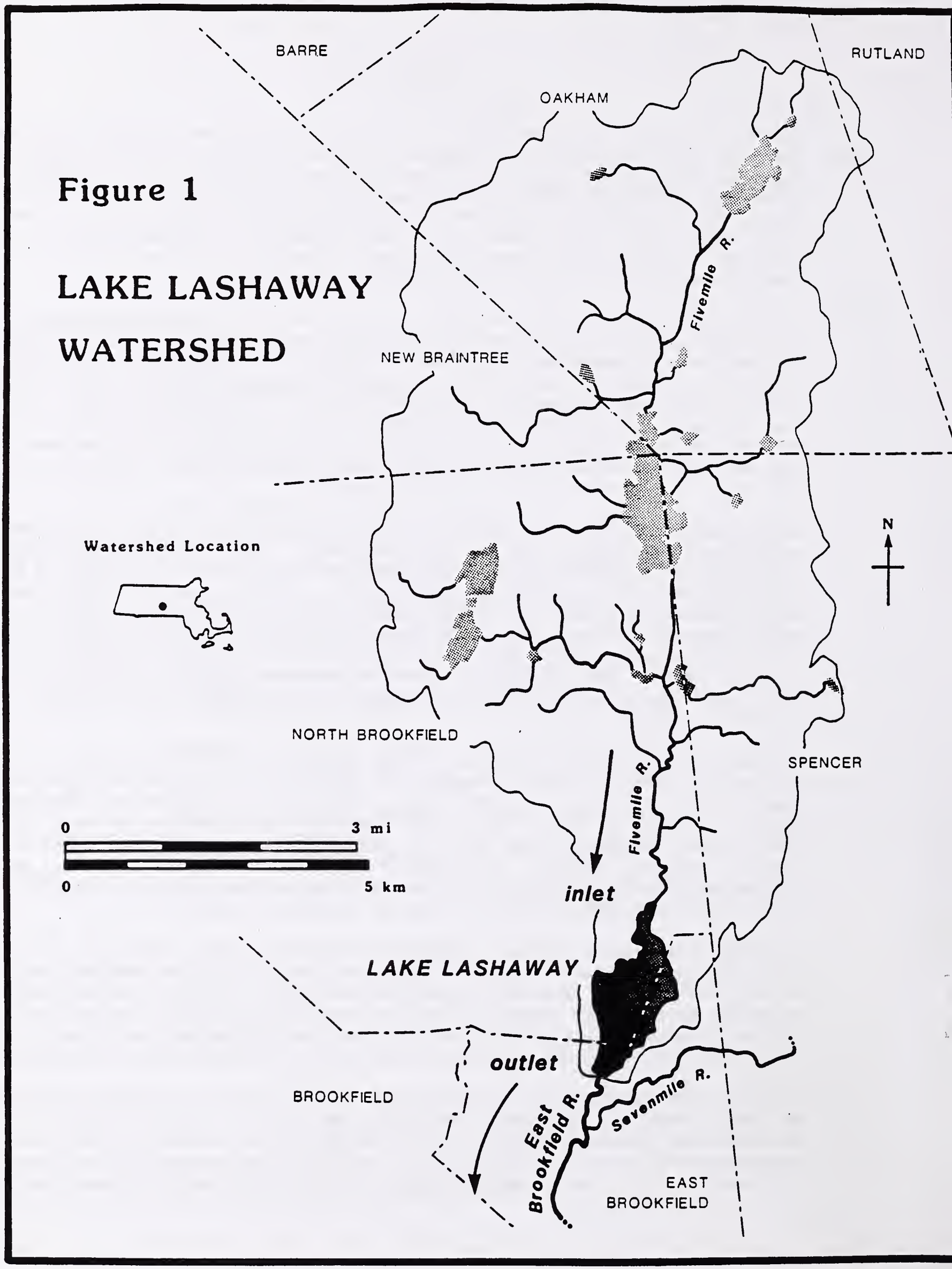
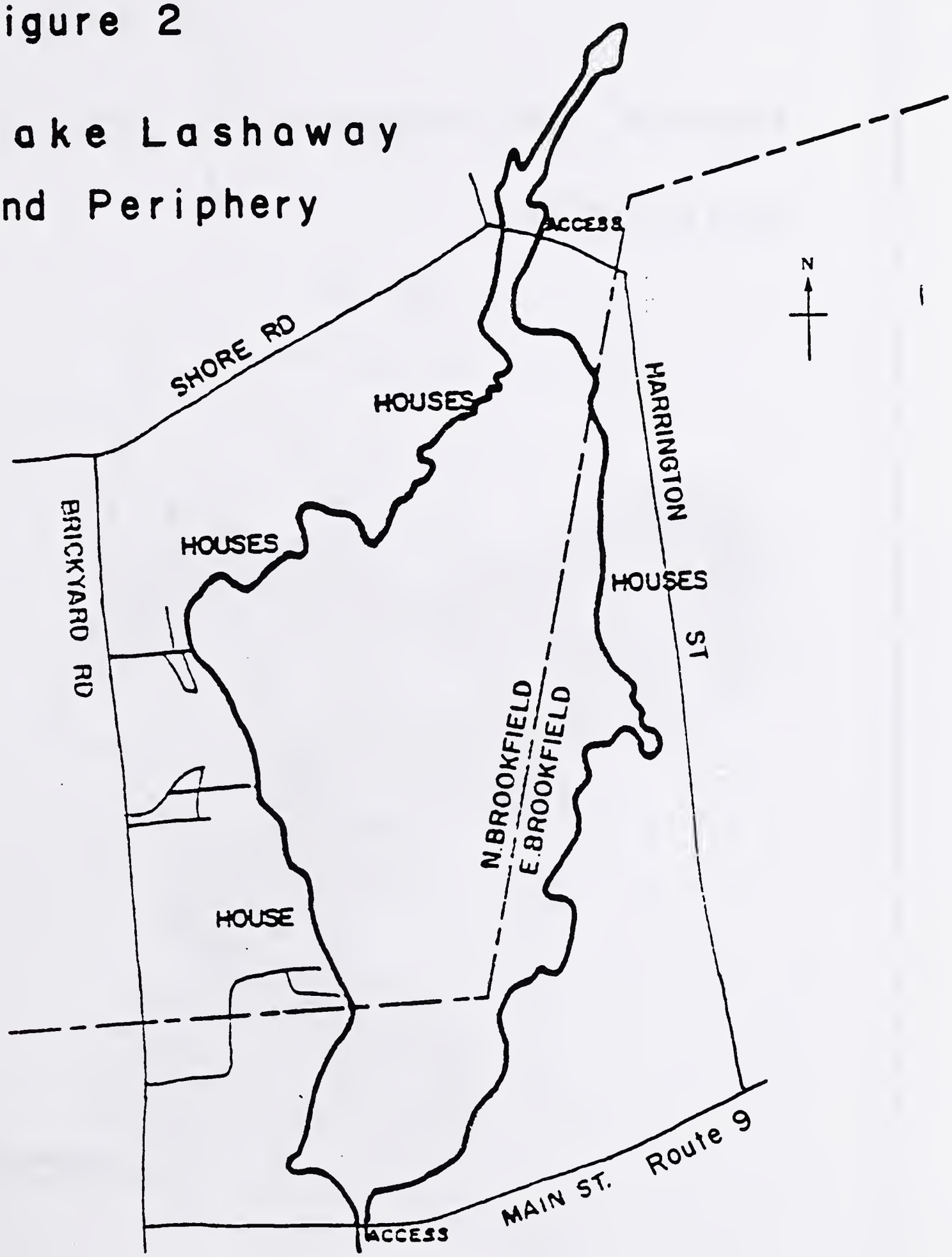


Figure 2

Lake Lashaway and Periphery



Modified from McCann et al. (1972)

Figure 3 LAKE LASHAWAY

BATHYMETRY

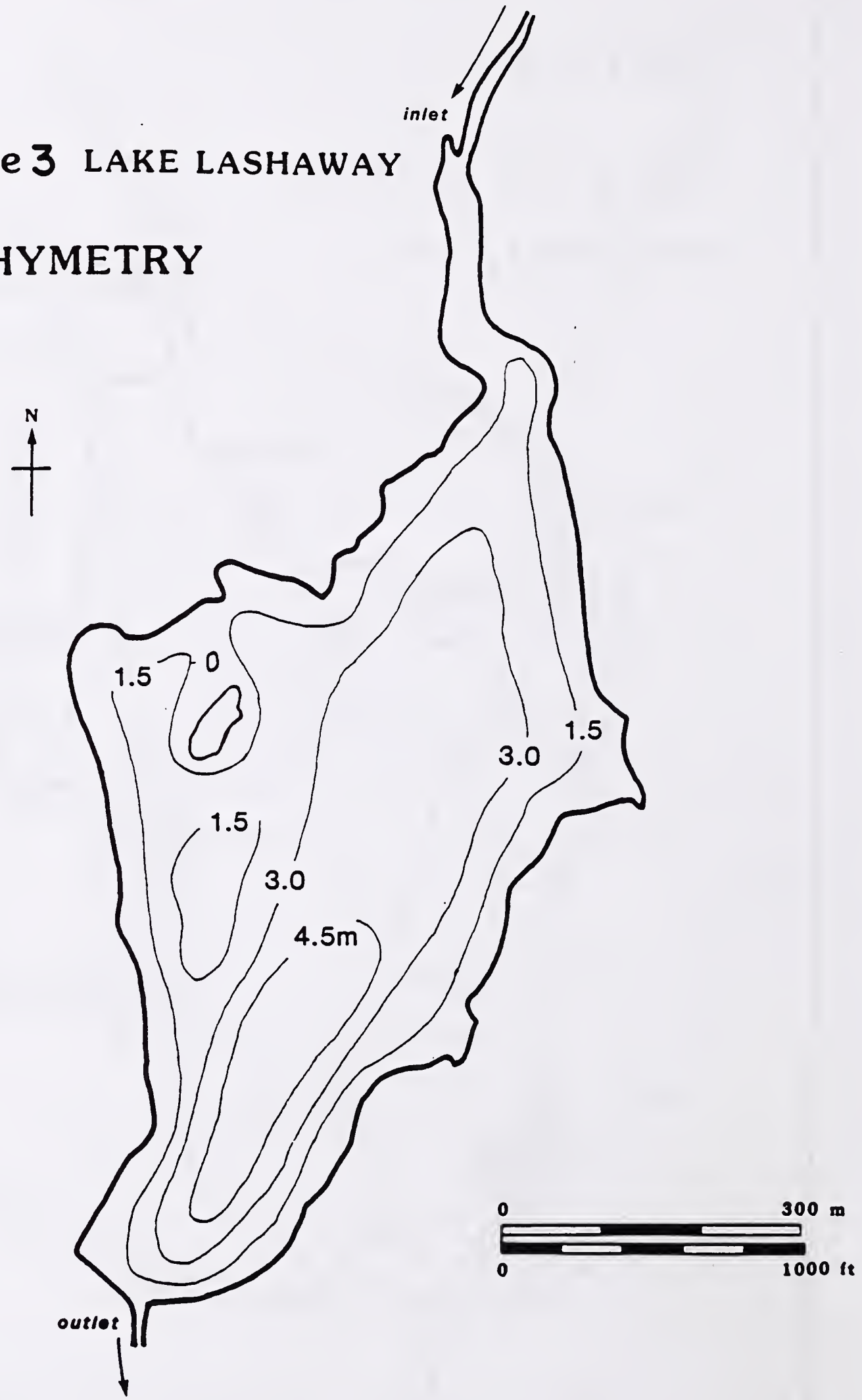
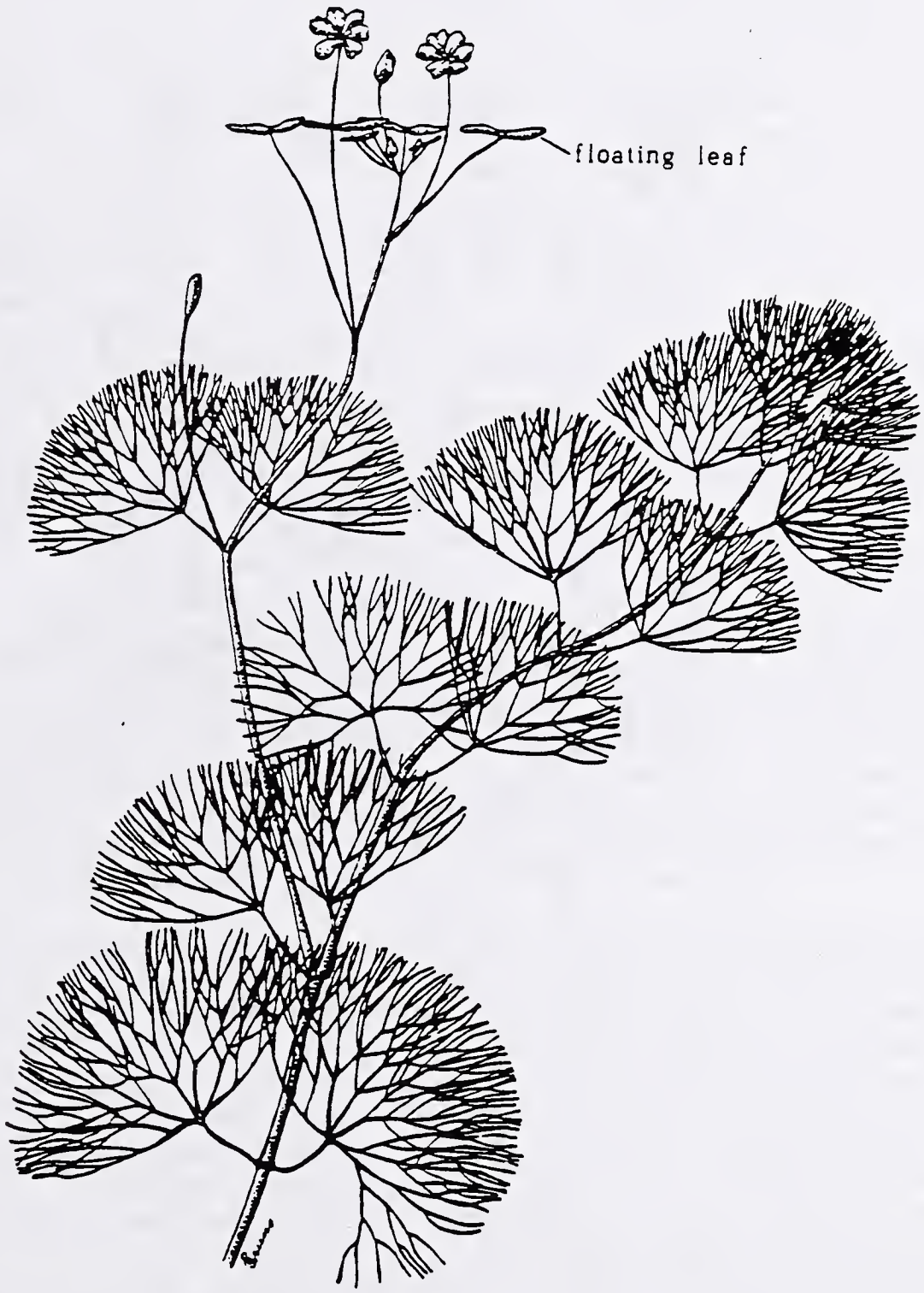


Figure 4

Cabomba caroliniana Gray



From Hellquist and Crow (1984)

Figure 5

Najas flexilis (Willd.) Rostk. & Schmidt

From Hellquist and Crow (1984)

report was issued the following January (Lycott 1979). Lycott established that nearly three-fourths of the phosphorus load to the lake was derived from two nonpoint sources: on-site sewage disposal (54%) and agricultural runoff (19%). The 200 homes circling the shoreline contributed approximately 19% to the phosphorus load, or about one-third of the load derived from on-site sewage disposal systems.

At the urging of Robert Munyon, Lake Lashaway Community Association (LLCA) President, the towns of East and North Brookfield formally applied to the Massachusetts Water Resources Commission for funds under the provision of Chapter 722, the "Eutrophication and Aquatic Vegetation Control Program." The Commission approved only nine applications for chemical control of nuisance vegetation in 1979, including that submitted by East Brookfield and North Brookfield for Lake Lashaway. The lake had previously been subjected to annual chemical treatments from 1972 to 1977 to control fanwort and/or bushy pondweed, but lack of adequate funding and "strong water movement" were among several reasons stated by Lycott (1979) for insufficient control of these macrophytes. Ironically, application of herbicides to control C. caroliniana apparently stimulated a nuisance growth of the N. flexilis population. In a more recent publication, Hellquist and Crow (1984) contend that "...herbicides and mechanical harvesting have proven completely ineffective for controlling..." C. caroliniana.

Robert Munyon's decisive actions initiated a series of events that led eventually to the Phase II restoration project discussed in this report. Munyon's desire for a long range management program coincided with the emergence of the U.S. EPA's Clean Lakes Program (CLP). The regulations governing the CLP became effective on February 5, 1980, yet ten months prior to this date Munyon established written communications with the Region I Office of the U.S. EPA.

In his letter of April 30, 1979 Munyon inquired about the adequacy of the recently completed eutrophication study by Lycott (1979) towards satisfying the proposed CLP regulations governing Phase I diagnostic-feasibility studies. Ronald G. Manfredonia's (U.S. EPA, Water Quality Branch) letter of response dated May 8, 1979 (Appendix II) indicated that several steps were necessary to complete the feasibility portion of the eutrophication study. He also discussed CLP funding contingent upon "finalization of the proposed regulations as written." Manfredonia's letter provided Munyon with direction and further motivation to pursue a long-term restoration project for Lake Lashaway.

To complete the feasibility portion of the eutrophication study, the town of East Brookfield applied for a Phase I assistance agreement, which was approved by the U.S. EPA on March 27, 1980. Part of the Phase I funds were used to reimburse East Brookfield, North Brookfield, and the Lake Lashaway Community Association for 70% of their monetary contributions to the aforementioned study. The remaining funds were used for consultant services to complete the following tasks: sanitary survey of houses abutting the lake; design plans for an outlet structure to facilitate drawdown of the lake; and an environmental assessment of the proposed drawdown. IEP Inc. of Wayland, Massachusetts completed these tasks and subsequently issued two reports: Lake Lashaway Sanitary Survey Report (IEP 1980); and the Lake Lashaway Drawdown Program - Outlet Design and Environmental Assessment Report (IEP 1981). The U.S. EPA approved both reports as fulfilling certain special award conditions of the Phase I assistance agreement, and on March 3, 1982 the EPA provided final written approval of the completed Phase I diagnostic/feasibility study of Lake Lashaway.

FUNDING

The federal share of funding for the Lake Lashaway Phase II project was provided through Section 314 of the Clean Water Act of 1977 (Public Law 95-217). Section 314 "directs the [U.S. EPA] Administrator to make financial assistance available to the States, and authorizes funding" (U.S. EPA 1980). Financial assistance was provided in the form of a cooperative agreement between the U.S. EPA and the Commonwealth's Department of Environmental Quality Engineering (name subsequently changed to Department of Environmental Protection), Division of Water Pollution Control (Division).

On February 4, 1981 the U.S. EPA offered the Division a financial assistance agreement (No. S001342011) in the amount of $103,800 for the Phase II Restoration Project of Lake Lashaway. An additional $95,000 for construction was added on June 25, 1981 as the result of an amendment requested by the Division. This action raised the federal share to $198,800 and total project cost to $397,600. The actual expenditure of funds to complete this project was $298,400.62, and the federal contribution was $149,200.31.

The 50% non-federal share ($149,200.31) of the actual project cost was derived from state and local sources. The Commonwealth's Chapter 628 (Acts of 1981) Clean Lakes and Great Ponds Program was the source of the state share, as authorized by the Water Pollution Control and Water Conservation Loan Act of 1982 (Chapter 286). The towns of East Brookfield and North Brookfield each appropriated $25,000 toward the Phase II Restoration Project of Lake Lashaway.

Since Lake Lashaway is included in the corporate limits of both East Brookfield and North Brookfield (Figure 2), the Division required a mutual agreement between the towns before it would execute a Substate Agreement with one of the towns for the Section 314 restoration project. Consequently, an Intermunicipal Agreement for Construction (Appendix III) was executed by the respective Boards of Selectmen on June 1, 1982 and, based on the authority granted by town meeting votes, it specified that "East Brookfield shall ... accept, receive, manage, and expend without further appropriation funds... made available through federal and state agencies," among other terms. Thus, the town of East Brookfield became the grantee.

It is noted here that the Commonwealth of Massachusetts, through its Department of Environmental Quality Engineering, funded a separate Phase II project (No. 628-84-14) to dredge sediments from the northern cove of Lake Lashaway. A grant of $37,500, or 75% of the total estimated project cost, was awarded to the town of North Brookfield through the Department's Clean Lakes and Great Ponds Program. J.D. Contracting, Inc. of East Longmeadow, Massachusetts billed North Brookfield in the amount of $48,450 for removal of 18,036 cubic yards of sediment during January and February, 1986. Thus, the actual amount that the Commonwealth reimbursed to North Brookfield was $37,337.50.

SCOPE OF SECTION 314 RESTORATION PROJECT

The discrete reimbursable tasks listed below are major components of the scope of work specified under Section A.3 of the aforementioned Substate Agreement.

- Construction of an outlet structure according to the engineering design specified in the Lake Lashaway Drawdown Program - Outlet Design and Environmental Assessment Report (IEP 1981).

- Construction of a temporary retention dam along the narrow portion of the Fivemile River at the north end of Lake Lashaway.

- Modification of the Brookfield Athletic Shoe Company's fire protection system as specified in the aforementioned report.

- Contingency plans to abate the effects of drawdown on the East Brookfield municipal well and homeowner wells within 500 feet of the lake.

- Collection and removal of exposed vegetation following lake drawdown.

- Documenting and reporting activities and results.

The town of East Brookfield was required to complete other, non-reimbursable, project tasks under section A.4 of the Substate Agreement. Filing and obtaining all local, state, and federal permits (refer to "Certificates and Permits") was one such task. Another was the appointment of a committee by the two towns for ..." short term and long term ..." management of the project. Accordingly, the first meeting of the "Lake Lashaway Restoration Committee" was convened at the East Brookfield Municipal Building on November 17, 1982. Robert Munyon and Robert Barton were elected Chairman and Secretary, respectively. One long-term responsibility of the Restoration Committee was to determine, on a yearly basis, when the lake would be lowered each fall.

CONCEPTUAL DESIGN OF DRAWDOWN STRUCTURE

In their feasibility study of Lake Lashaway, IEP (1981) concluded that an 8 foot drawdown would control nuisance aquatic vegetation adequately, but a 10 foot drawdown "would be optimal" because it would provide additional flood storage capacity and greater dewatering and consolidation of lake sediments for any potential dredging project. A 10 foot drawdown would lower the surface of the lake from a set elevation of 614.0 feet (MSL) to 604.0 feet. Among many possible adverse effects from a drawdown of this magnitude was the major concern of the Brookfield Athletic Shoe Company (BASC) that an adequate water supply would still be available from the lake for its fire protection system.

Upon investigation, IEP determined that the Shoe Company's intake pump centerline was located at 609.7 feet, or 4.3 feet below the surface elevation when the lake is at full capacity. The Company's insurer set a maximum allowable drawdown at the pump centerline, whereas the pump manufacturer required a minimum head of 12 inches above this depth. This latter restriction would reduce the maximum

potential drawdown depth to 610.7 feet. IEP subsequently determined that a 3.3 foot drawdown to elevation 610.7 feet would not be effective, and its subcontractor (Greenman-Pedersen Associates) concluded that designing and locating an outlet structure to include a modified fire protection system intake for BASC based on an 8 foot drawdown was feasible and cost effective.

One alternative considered for the location of a drawdown structure was the existing arched spillway affixed to the Route 9 bridge. This option was disallowed by the Massachusetts Department of Public Works (MDPW) since the spillway is an integral component of the state highway bridge. The MDPW's major concern was that the integrity of the bridge structure might be compromised during any construction. Installation of a culvert and gate west of the Route 9 bridge also proved to be impracticable due to the physical limitations at this site. Final resolution of the problem consisted of a 140 foot concrete culvert constructed through the lake dam and below the Route 9 roadway east of the existing bridge and arched spillway.

Due to the slope of the lake basin at the dam, the outlet chamber was designed to be placed in 10 feet of water and to extend above the lake surface. This necessitated inclusion of an access catwalk from the sidewalk to the outlet chamber (refer to cover photograph). The design appurtenances also included a trash rack; stop planks; antiseep collars along the culvert to protect the integrity of the dam and the overlying roadway (Route 9); a headwall to support the dam's downstream embankment; and energy dissipators to prevent scour and erosion of the downstream site (refer to Greenman-Pederson, Associates' Drawing Nos. 79206-1 and 79206-2 in Appendix IV).

As built, the outlet structure provides control of drawdown and refill of Lake Lashaway by a manually - operated sluice gate (primary) and stop plank (secondary) system. At the time of drawdown, the sluice gate is opened slightly to relieve pressure once the chamber is flooded. The top stop plank is then removed to allow filling of the chamber. Additional planks can be removed as the lake level drops, and the sluice gate opening can be increased, but the flow rate must not exceed the highest mean monthly flow (90.5 cfs) recorded for the lake outlet. The procedure is reversed during the spring to refill the lake while maintaining a downstream flow of at least 3.2 cfs (seven-day, ten-year low flow value).

The outlet structure design by GPA also included the following modifications to the BASC fire protection system: lowering of the intake; freeze protection of the exposed intake piping; and installation of a vacuum priming system. The detailed construction drawings and associated technical specifications for the entire project are contained in a separate volume (Appendix D) of the feasibility study by IEP (1981) titled: Contract Documents for the Construction of a Culvert and Outlet Works at Lake Lashaway.

PERMITS AND CERTIFICATES

An annotated list of all actions taken by local, state, and federal agencies with authority to issue permits or certificates pertaining to construction activities and/or drawdown of Lake Lashaway is included in Appendix V. Copies of decisions rendered by these same agencies are also included in this appendix. Collectively, these actions served to complete task A.4.2 of the Substate Agreement.

PROJECT DELAYS

The design phase for the outlet control structure at Lake Lashaway was delayed during negotiations with Brookfield Athletic Shoe Company, and revisions to the initial design were necessary to mitigate BASC's concerns. Also, a drawdown limit of eight (8) feet was established to assure an adequate supply of lake water to the Shoe Company's modified fire protection system. Further details on this subject are provided in the Lake Lashaway Drawdown Program -Outlet Design and Environmental Assessment Report (IEP 1981).

Typically there were some minor delays during the construction phase as well. The consultant that managed construction of the outlet control structure (Greenman-Pedersen Associates) needed to submit seven change orders (i.e., "Extra Work Orders") to the Division for approval. Copies of these change orders are provided in Appendix VI, and they include the additional costs engendered by the extra work, which totaled $21,364.35.

Delays during construction were negligible, as evidenced by the official opening of the valve to initiate the first drawdown of Lake Lashaway. This event occurred on November 19, 1982, only 80 days following the start of construction. However, the initial drawdown was limited to approximately 2 feet because there was no mechanism in place to prevent dewatering of the upstream wetlands adjacent to the Fivemile River. Although the outlet control structure was functional at this time, site restoration had to be delayed until the following spring.

There was considerable deliberation among local, state, and federal representatives about scope of work task A.3.4 of the Substate Agreement, which specified construction of a temporary retention dam across the Fivemile River, about 1000-1500 feet upstream from the Harrington Street bridge (Figure 2). The initial Army Corps of Engineers (ACOE) Section 404 Permit (refer to Appendix VI) issued on October 4, 1982 approved construction of a temporary sand bag cofferdam to prevent dewatering of upstream wetlands. Subsequent indecision on the design and permanence of proposed dams, and objections by an abutter to the proposed location of a dam, delayed completion of the restoration project at Lake Lashaway. All parties eventually agreed to the construction of a semi-permanent check dam just downstream of the Harrington Street bridge (refer to "Protection of Upstream Wetlands"), and an amended ACOE Permit was issued on September 23, 1983. The first complete 8 foot drawdown of Lake Lashaway was finally realized during the winter of 1984-85.

PROTECTION OF UPSTREAM WETLANDS

The limit placed on the initial drawdown of Lake Lashaway was based on the IEP (1981) prediction that lowering the water level more than 2 feet for a period of 6 months would result in partial dewatering of upstream wetlands that border the Fivemile River for a distance of approximately 1000 feet north of the Harrington Street bridge (Fig. 2). Further, IEP predicted that dewatering would result in erosion of organic matter and silt, which would be transported to Lake Lashaway, and concomitant alteration of the wetlands flora to, e.g., a "wooded swamp." To mitigate these probable events, IEP (1981) recommended construction of a temporary or permanent water level maintenance structure, or check dam.

The Phase II Restoration Project Substate Agreement included specifications for "a temporary retention dam... upstream of the Harrington Street bridge" but, as previously explained, a semi-permanent dam was eventually constructed just south of this bridge. The simple, efficient design of the check dam consisted of four 20 foot long precast concrete "Jersey" barriers resting on a concrete base, with gravel fill between adjacent pairs of barriers. Stop log channels are mounted to the opposing upstream pair of barriers, and flow is controlled with 7'x6"x6" wood logs. Installation of stop logs in the fall has successfully prevented dewatering of upstream wetlands, whereas their removal in the spring facilitates upstream migration of spawning fish populations and passage of boats.

Chase Precast Corporation of North Brookfield, Massachusetts provided the construction drawing (#C-10027, Appendix VII) of the check dam and they cast the "Jersey" barriers. David A. Robinson Contracting of Barre, Massachusetts built the check dam during December, 1983. The total cost of construction was $7218, which was funded as a reimbursable task under Paragraph A.3.4. of the Section 314 Phase II Substate Agreement. The federal share of this task was $3609.

RESULTS AND DISCUSSION

Control of Macrophytes

As shown in Fig. 6, the Massachusetts Division of Water Pollution Control mapped the percent cover of macrophytes in Lake Lashaway on August 4, 1982 just prior to Phase II construction of the outlet control structure. Although frequency of occurrence data were not recorded for each species population, it is evident in Fig. 6 that nuisance macrophytes had further inundated the lake since the eutrophication study by Lycott in 1978. To visualize the severity of the problem in 1982, one can mentally superimpose Fig. 6 onto the bathymetric map of the lake (Fig. 3). It becomes apparent that macrophytes covered approximately 70% of the lake to a depth of at least 3 meters (10 feet) in all areas except the southeastern littoral zone.

Post construction maps depicting the percent cover of macrophytes in mid-summer are presented in Figs. 7, 8, and 9 for the years 1986-88. Even a cursory glimpse of these figures reveals that decimation of nuisance macrophytes following drawdown of Lake Lashaway is unequivocal. Except for scattered communities on the east and west shorelines, and the island, the lake basin exhibited sparse populations of macrophytes (Fig. 7) on July 7, 1986 following two successive 8 foot winter drawdowns. The nineteen macrophyte species recorded for this date are listed in Table 1 and, not surprisingly, most are characterized as inhabitants of shallow water or shorelines.

Table 1 also presents macrophytes in order of their frequency of occurrence on July 7, 1986. It should be noted that both C. caroliniana and Najas sp. (presumably N. flexilis) were observed in no more than one of every four observations. In stark contrast, Lycott (1979) reported that C. caroliniana covered 68 acres to a depth of 1.5 meters (5 feet) and that N. flexilis covered 80% of the littoral zone. The population of N. flexilis was uncharacteristically growing to the lake's surface between 2 and 6 feet in depth. These two nuisance macrophytes covered 40% of the surface area of Lake Lashaway in 1978.

The percent cover of macrophytes in the scattered communities along the east and west shorelines evident in Fig. 7 appeared to decline further following subsequent annual drawdowns of Lake Lashaway (Figs. 8 and 9). By August 12, 1988 the percent cover of all macrophytes was low throughout the lake (Fig. 9). Coincident with these observations are the corresponding frequency of occurrence data listed in Table 1, which serve to record possible shifts in the composition of species populations. Seven of nineteen species populations recorded for Lake Lashaway in 1986 were not observed by the Division's Clean Lakes Program staff during their macrophyte surveys in the summers of 1987 and 1988. In addition, diminished frequency of occurrence was recorded for Pontederia cordata L., Gratiola sp., Najas sp., Myriophyllum sp., Saggitaria latifolia Willd., Sparganium sp., and Myosotis sp. The frequency of occurrence of C. caroliniana, Eriocaulon sp., Eleocharis sp., and Typha latifolia L., were relatively stable during this interval of time. Potamogeton bicupulatus Fernald may have experienced population growth (Table 1) as a consequence of repeated drawdowns and/or the aforementioned shifts in species populations. It should be noted, however, that although Table 1 data are based on numerous observations, they are not quantified observations and they are not amenable to statistical evaluations.

Figure 6 LAKE LASHAWAY

PRE-RESTORATION AQUATIC MACROPHYTE PERCENT COVER 4 AUGUST 1982

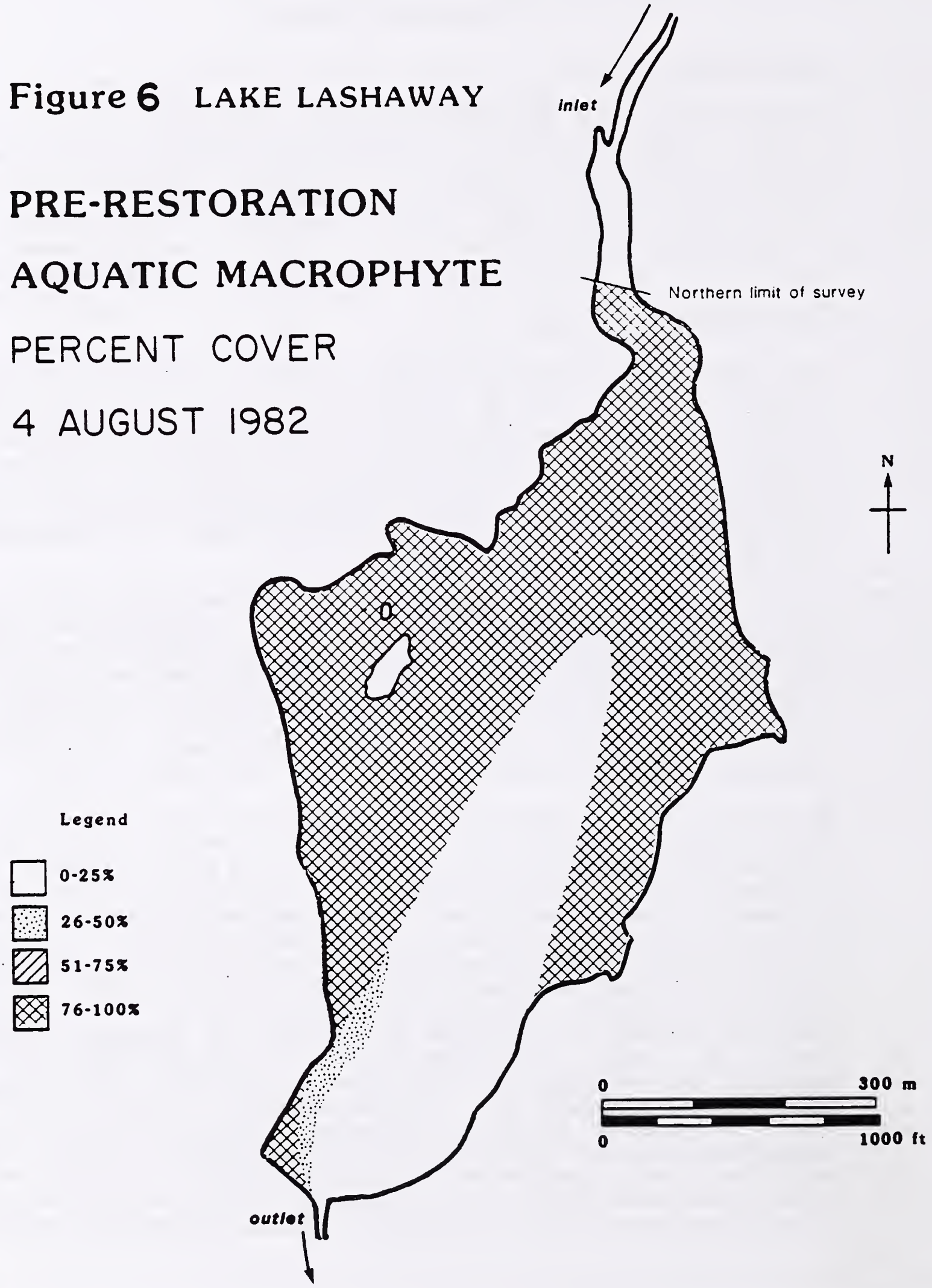


Figure 7 LAKE LASHAWAY

POST-RESTORATION AQUATIC MACROPHYTE PERCENT COVER

7 July 1986

Figure 8 LAKE LASHAWAY

POST-RESTORATION AQUATIC MACROPHYTE PERCENT COVER

22 July 1987

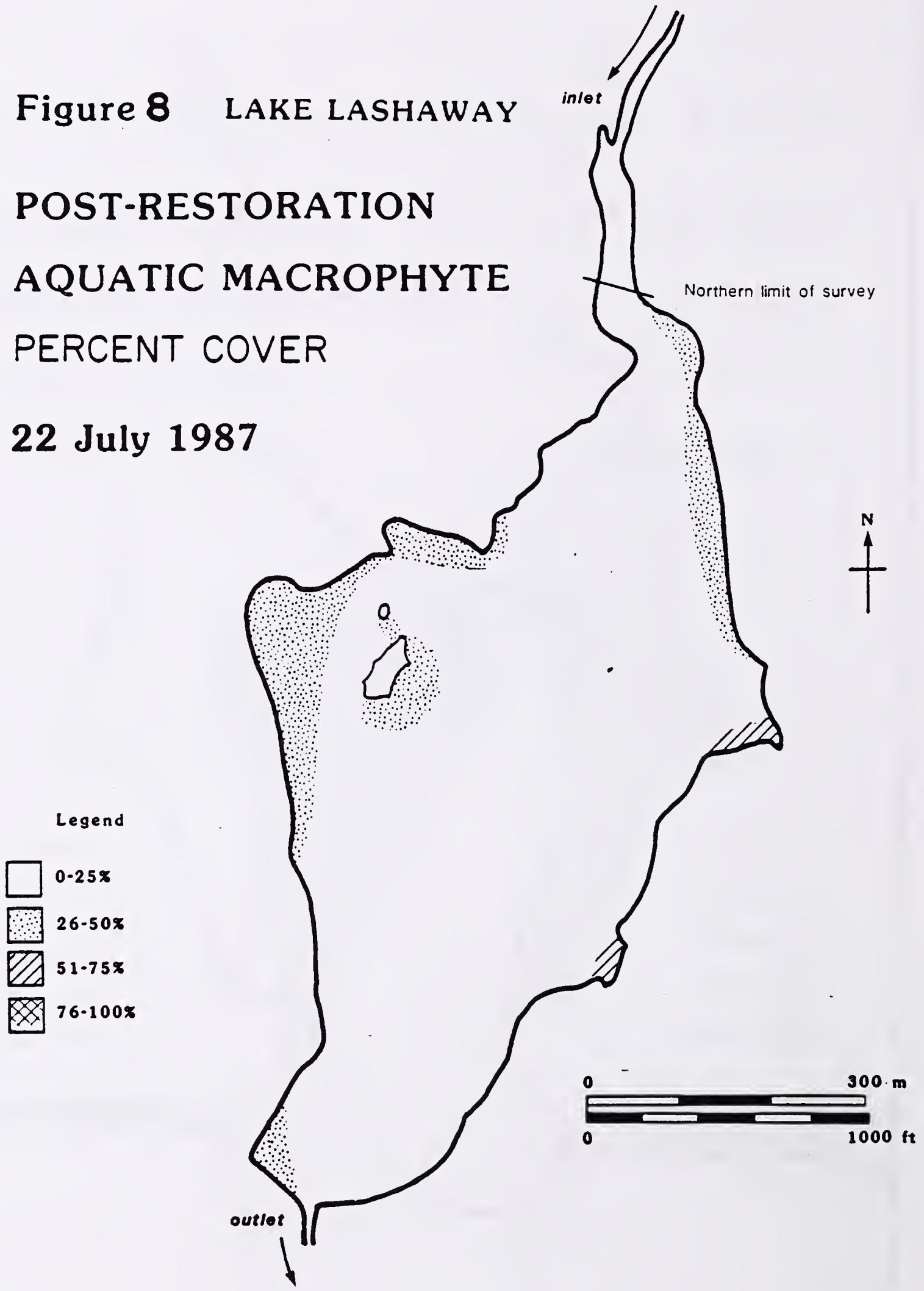


Figure 9 LAKE LASHAWAY

POST-RESTORATION AQUATIC MACROPHYTE PERCENT COVER

12 August 1988

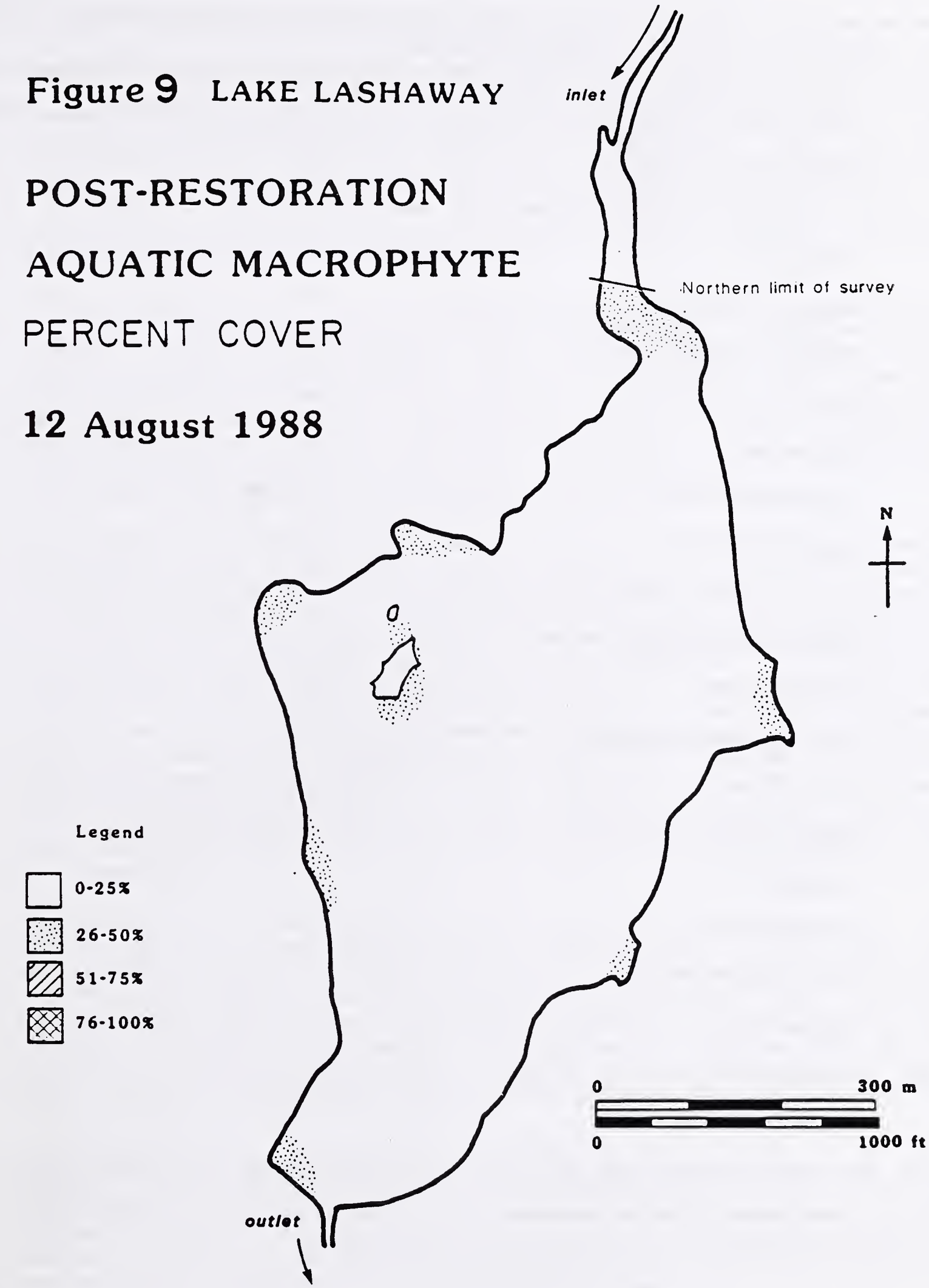


Table 1. Lake Lashaway post-construction aquatic macrophyte surveys. Data reported as frequency of occurrence (%).

MACROPHYTE SPECIES	7 July 1986	22 July 1987	12 August 1988
Pontederia cordata L.	44	20	12
P. cordata f. taenia Fassett	--	8	4
Gratiola sp.	28	12	4
Cabomba caroliniana Gray	24	16	20
Brasenia schreberi Gmel.	20	--	--
Najas sp.	16	4	4
Eriocaulon sp.	12	8	12
Myriophyllum sp.	12	--	4
Potamogeton sp.	12	--	--
P. bicupulatus Fernald	--	12	8
Sagittaria latifolia Willd.	12	4	4
Sparganium sp.	12	4	4
Dulichium arundinaceum (L.) Britton	8	--	--
Elatine sp.	8	--	8
Eleocharis sp.	8	12	8
Myosotis sp.	8	4	4
Polygonum sp.	8	--	--
Sium suave Walt.	8	--	--
Chelone sp.	4	--	--
Ludwigia sp.	4	--	--
Typha latifolia L.	4	4	4
Total number species observed:	19	12	14

As reported in Cooke and others (1986), some of these results are not unexpected. For example, the decline of Brasenia schreberi Gmel., C. caroliniana, and Myriophyllum sp. following winter drawdown (Table 1) has been reported by other authors. The diminution of Najas sp. (presumably N. flexilis), however, was an unexpected benefit. In its feasibility report, IEP (1981) had questioned whether N. flexilis would be decreased by drawdown since populations of this species had previously exhibited an increase, and in some cases no change, subsequent to drawdown. Cooke and others (1986) listed N. flexilis among those species of macrophytes that typically increase in lakes subjected to drawdown. Similarly, Siver and others (1986) also reported increased growth of N. flexilis following drawdown of Candlewood Lake in Connecticut.

The reason most often cited for increased population growth of N. flexilis is its mode of reproduction, i.e., seeds, which are usually unaffected by the intermittent desiccation, freezing, and thawing that characterize winter drawdowns. Although C. caroliniana forms solitary emergent flowers from the axils of floating leaves, it is not known to produce viable seeds in Massachusetts lakes (personal communication with Dr. C. Barry Hellquist). Overwintering plants, vegetative fragments, and subsurface rhizomes are the usual modes of survival and reproduction in C. caroliniana, all of which proved susceptible to the events that accompanied drawdown of Lake Lashaway.

The capability of lowering water levels as much as eight feet during drawdown has not only reduced macrophyte populations dramatically, it has also facilitated a resurgence of recreation and shoreline management activities at Lake Lashaway. In 1985 the towns of East Brookfield and North Brookfield cooperated in establishing a new public beach that is supervised by lifeguards. Improvements to this beach have been made each year. During the winter of 1985-86, soft sediments were dredged from the north cove of the lake, which allowed the Lake Lashaway Community Association an opportunity to fund and construct a permanent concrete boat ramp at that location. Both on-lake and off-site boaters now have easy, safe access for the first time since the mid-1970's. In 1989 the Sail Club sponsored a regatta that attracted crews from Georgia, Missouri, Illinois, Indiana, Ohio, and South Carolina. The following year the Ski Club was reformed and a course was established on the Lake for water-skiers. And finally, the Massachusetts Bass Fishing Club has put Lake Lashaway back on its regular circuit for tournaments.

Drawdown also exposed about one thousand tree stumps along the littoral zone that posed a danger to water-skiers; caused damage to boat props, keels and centerboards; and were a nuisance to fishermen. Volunteers cut off the exposed portion of each stump; the remaining stump base and root system froze in the ice during the winter and they were subsequently uplifted out of the sediments when the lake was refilled in the Spring. This process was repeated over several winters from 1985-88 until virtually all stumps were hauled out of the Lake. Today, the Lake is once again near its full potential for recreational and aesthetic enjoyment.

As a final note, the Division of Water Pollution Control invited the Lake Lashaway Community Association, Town of East Brookfield, and Town of North Brookfield to provide their respective written perceptions on the Section 314 Restoration Project. Representatives of all three civic groups were quick to respond, and their letters of testimony (Appendix VIII) support the Division's conclusion that this project was an unqualified success.

Monitoring Program

The Massachusetts Division of Water Pollution Control, Technical Services Branch, conducted the Phase II restoration monitoring program of Lake Lashaway to assess potential adverse effects during construction of the outlet control structure as well as to determine the potential in-lake and downstream effects of repeated drawdowns. This program extended from August 4, 1982 through August 9, 1989 and included monthly surveys before, during, and after construction. Monitoring the lake's macrophyte community has been discussed previously.

In-lake, inflow, and outflow water quality were monitored at three stations as described below.

Station 1. An in-lake station located at the deepest point of the basin (refer to Fig. 3). Grab samples were collected at the surface and at 0.5 m above the lake bottom (on 28 of 34 dates collections were taken from the 4.0 m depth, and on other dates at 3.0 m or 3.5 m). It is noted here that no in-lake samples were collected during drawdown of Lake Lashaway as it was impractical to do so.

Station 2. The inlet tributary, or Fivemile River, was sampled upstream of the check dam, on either side of the Harrington Street bridge (refer to Fig. 2).

Station 3. When the lake was at or near full capacity, the outflowing water was sampled from a boat on the lake side, or north side, of the arched spillway affixed to the Route 9 bridge. During lake drawdown, outflowing water was monitored just downstream of the drawdown culvert and energy dissipators on the south side of the Route 9 bridge. Access to the latter site was by way of a footpath.

At each station, and on each sampling date, data were typically generated for the following chemical and physical parameters: total solids, suspended solids, total phosphorus, total Kjeldahl nitrogen, ammonia and nitrate nitrogen, total hardness, total alkalinity, chloride, specific conductance, pH, dissolved oxygen, and temperature. The last four parameters were measured with a Hydrolab Digital 4041 field unit. On most dates samples were also collected to estimate fecal coliform bacteria. Secchi disk transparency was measured at Station 1.

A 2 liter volume PVC Kemmerer bottle with neoprene end caps was used to collect in-lake water samples at various depths; otherwise, grab samples for chemical parameters were collected by hand in 1 liter glass bottles with Teflon-lined caps. A separate bottle was used to collect water samples for analyses of total phosphorus, total Kjeldahl nitrogen, ammonia and nitrate nitrogen, and total hardness at each station. These samples were fixed upon collection with 4 ml of 1:1 sulfuric acid. Grab samples for coliform bacteria were collected in 200 ml autoclaved bottles. All water samples were labeled, placed in chests with ice, and transported to the Department of Environmental Protection's Lawrence Experiment Station for analytical tests following the most recent edition of Standard Methods for the Examination of Water and Wastewater, which is published jointly by the American Public Health Association, American Water Works Association, and the Water Pollution Control Federation.

The tabulated database for the seven year monitoring program is presented in Appendix IX. Although there are in excess of 2500 entries, only selected data were analyzed to answer the following pertinent questions that relate to the purpose of the monitoring program. Did construction result in the resuspension of solids that could have an adverse impact on downstream water resources? Did winter drawdown flush solids and/or nutrients out of Lake Lashaway to the East Brookfield River? And finally, were there any violations of Massachusetts Surface Water Quality Standards (1985) during either construction of the outlet structure or drawdown of the lake?

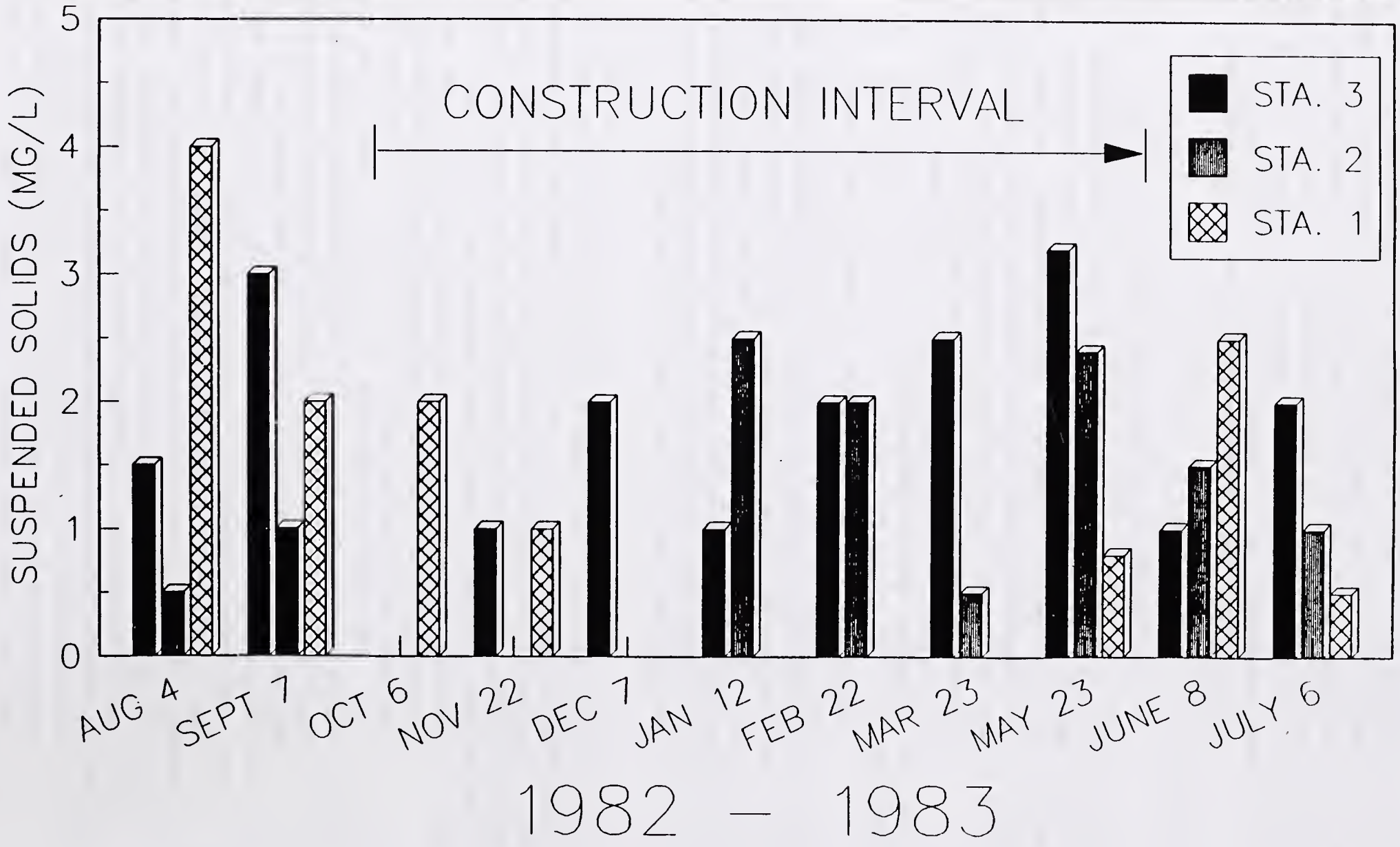
The Massachusetts Surface Water Quality Standards (314 CMR 4.00) are adopted by the Division of Water Pollution Control "pursuant to the provisions of M.G.L. c. 21, s. 27." The applicable criteria for the Class B waters of Lake Lashaway, the Fivemile River, and the East Brookfield River during the monitoring program are provided in Appendix X of this report. A close examination of the criteria and the monitoring program database (Appendix IX) reveals that there were no violations during the seven years of monitoring. This includes periods during construction of the outlet control structure, dredging of the north cove area (a separate state-local project explained under "Funding"), and the seven sequential winter drawdowns.

Statements in the previous paragraph are based, in part, upon samples of outflowing lake water (Station 3) and measurements of the specific parameters (temperature, dissolved oxygen, pH, and fecal coliform bacteria) that constitute "additional minimum criteria" for Class B water quality. The maximum temperature ($26.0^{\circ}C$) at Station 3 did not equal or exceed the $28.3^{\circ}C$ criterion to support a warm water fishery, the lowest recorded dissolved oxygen concentration (7.2 mg/l) was well above the minimum of 5.0 mg/l, and there were no violations of the fecal coliform criterion (Appendix X).

Fifty-five percent of pH values measured at Station 3 did fall below the range (pH 6.5-8.0) for Class B water, but not as a consequence of construction or drawdown. The low pH of water flowing out of Lake Lashaway (range of 5.1-7.9) primarily reflects the hydrogen ion activity of water flowing into the lake (range of 5.2-8.2). Lycott (1979) also reported low pH values at the inlet to Lake Lashaway. Therefore, if there is a violation of the pH criterion, and none is suspected, it occurs upstream of the lake. The more likely explanation for low pH is the low total alkalinity (Appendix IX) and high dissolved organic acid content of inflowing water that reflect natural conditions.

No excessive discharges of suspended solids were observed or recorded during construction of the outlet control structure. As depicted in Fig. 10, suspended solids in outflowing water (Station 3) were low during the interval of construction and, in fact, were not even detected on October 6 when the contractor was driving sheet piling into the substrate of Lake Lashaway near the outlet. In this instance, silt control measures may have effectively reduced outflowing solids below the in-lake concentration. It is notable that suspended solids measured from the outlet increased gradually during late winter and early spring while, at the same time, the load carried by inflowing water from the Fivemile River was gradually decreasing. This may be a consequence of in-lake mixing or growth of phytoplankton, but without in-lake data (Station 1) these suggestions cannot be affirmed. Final restoration of the construction site in the spring may also account for a small amount of uncontrolled runoff (Fig. 10).

FIGURE 10
EFFECTS OF CONSTRUCTION ON SUSPENDED SOLIDS



1982 – 1983

However, there appear to be no violations of the minimum criteria for Class B water quality (Appendix X) based on the suspension of solids during construction activities.

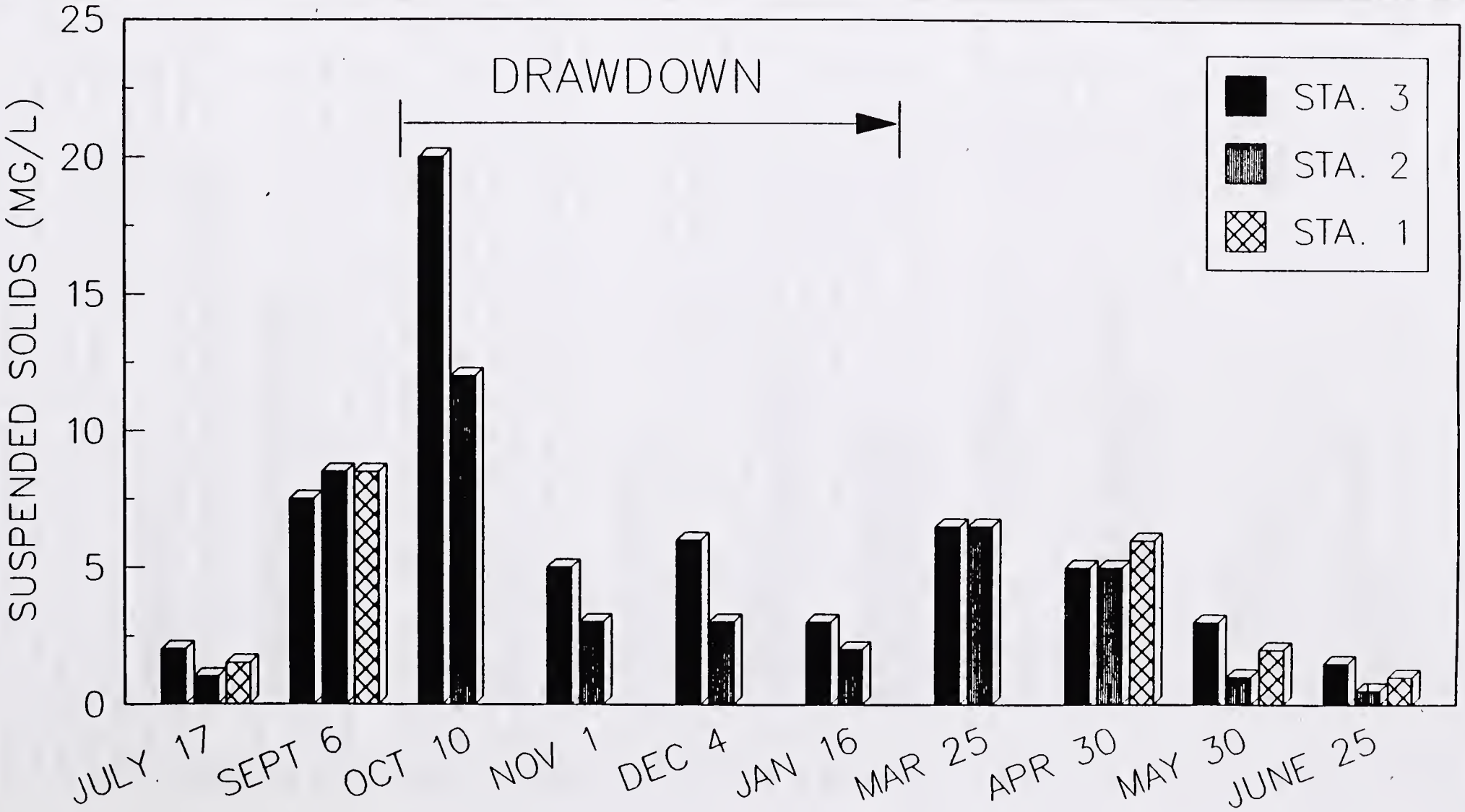
Although it has been established previously that the reign of nuisance aquatic plants was terminated in Lake Lashaway as a consequence of annual drawdowns, the question of whether the physical process of drawdown per se contributed any additional load of suspended solids or nutrients to the East Brookfield River and other downstream water resources has not been addressed. Fig. 11 depicts a comparison of suspended solids at Stations 1 to 3 prior to, during (except Station 1), and following the first 8 foot drawdown of the lake over the winter of 1984-85. Suspended solids were, with the notable exception of October 10, less than 10 mg/l. Only small differences occurred between sampling stations. The peak of 20 mg/l at Station 3 on October 10 was the highest concentration recorded for any station during the seven-year monitoring program, and it occurred just subsequent to the initiation of drawdown (Fig. 11). Without the benefit of in-lake data on this date, it appears that drawdown generated a brief surge of suspended solids that was discharged through the outlet culvert. However, the 12 mg/l value recorded for the inlet on this same date also represents the highest value at Station 2 during the monitoring program.

Antecedent rainfall is the most likely explanation for the peak concentrations of suspended solids noted above. The National Oceanic and Atmospheric Administration (1984) reported 1.79 inches of precipitation in the town of Ware, Massachusetts, just west of the Lake Lashaway Watershed, during the interval October 2-4, with further traces of precipitation on October 10 and 11. The same amount of precipitation was reported for the City of Worcester to the east. Thus, it appears that heavy precipitation may have washed suspended solids into Lake Lashaway just prior to the first 8 foot drawdown. There is insufficient information in the database to make a determination on whether drawdown also contributed to the 20 mg/l of suspended solids in the outflowing water on October 10, 1984.

A similar cause - effect relationship between onset of the 1986-87 winter drawdown in early November and the discharge of suspended solids from the outlet of Lake Lashaway seems apparent in Fig. 13. Specifically, suspended solids in outflowing water (2.5 mg/l) exceeded that recorded for the lake inlet (0.5 mg/l) by a ratio of 5:1 on November 12. Although both values are low, the substantial difference in concentration at these two stations warrants an explanation. In this instance, the inlet concentration of suspended solids declined four - fold from the pre-drawdown sampling date of October 7, whereas the outlet concentration declined by only 0.5 mg/l during the same interval (Fig. 13). Thus, there was no surge of suspended solids that was discharged to the outlet culvert and the East Brookfield River following the initiation of drawdown in November 1986.

During the winter drawdowns of 1984-85, 1985-86, and 1986-87 the suspended solids concentrations at the lake outlet typically exceeded that recorded for the Fivemile River inlet (Figs. 11, 12, and 13), although the differences were small and the concentrations were low. Since Lake Lashaway exhibits a moderate to high annual flushing rate (13 volumes per year, or once every 28 days), and since instantaneous flushing rates are likely to be higher during drawdown, close correspondence between Station 3 and Station 2 data are not surprising. Also, there are several probable explanations for the small differences that do exist between these two stations. There is, therefore, no evidence in the Monitoring

FIGURE 11
EFFECTS OF 1984–85 DRAWDOWN ON SUSPENDED SOLIDS



1984 – 1985

FIGURE 12
EFFECTS OF 1985–86 DRAWDOWN ON SUSPENDED SOLIDS

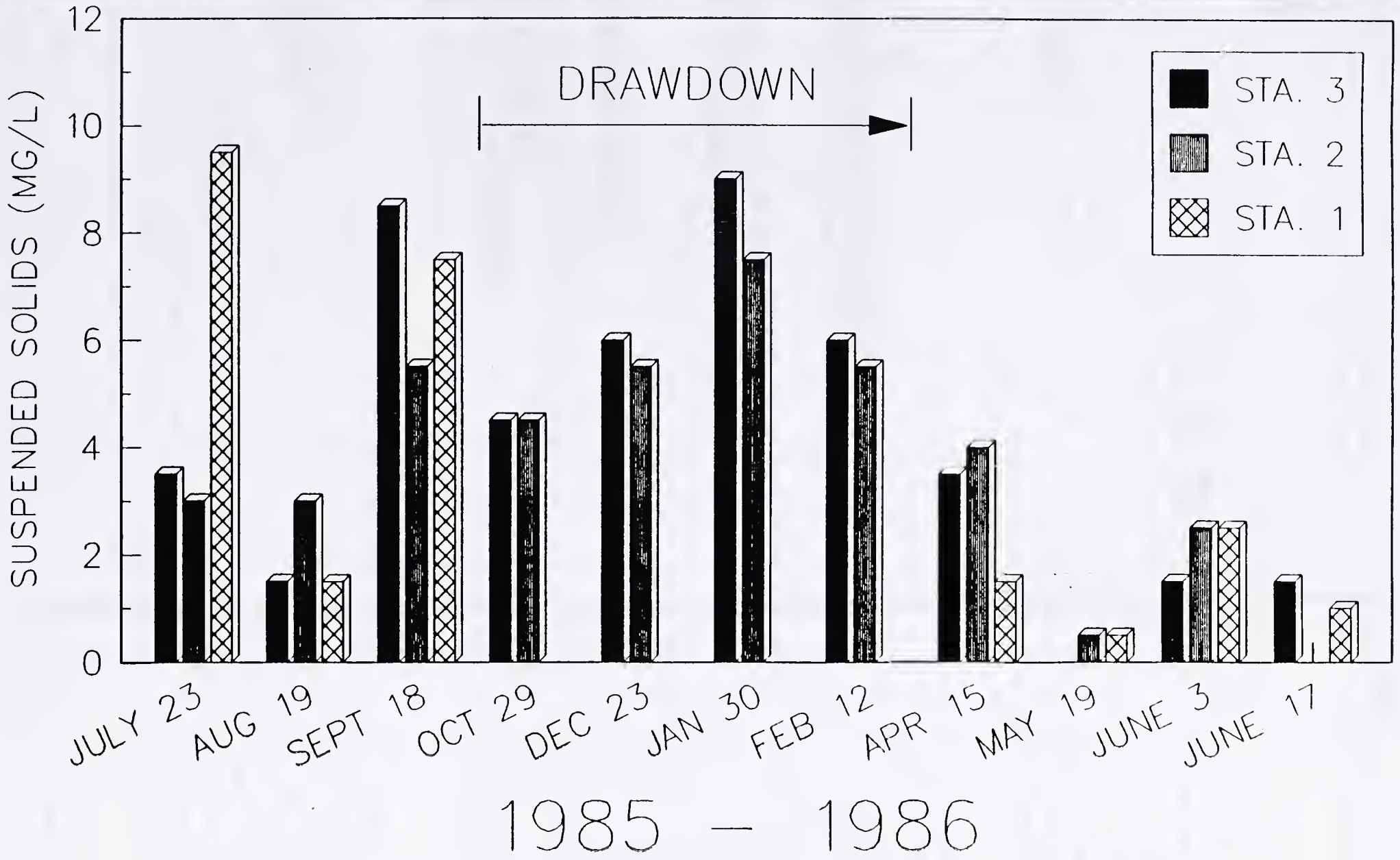
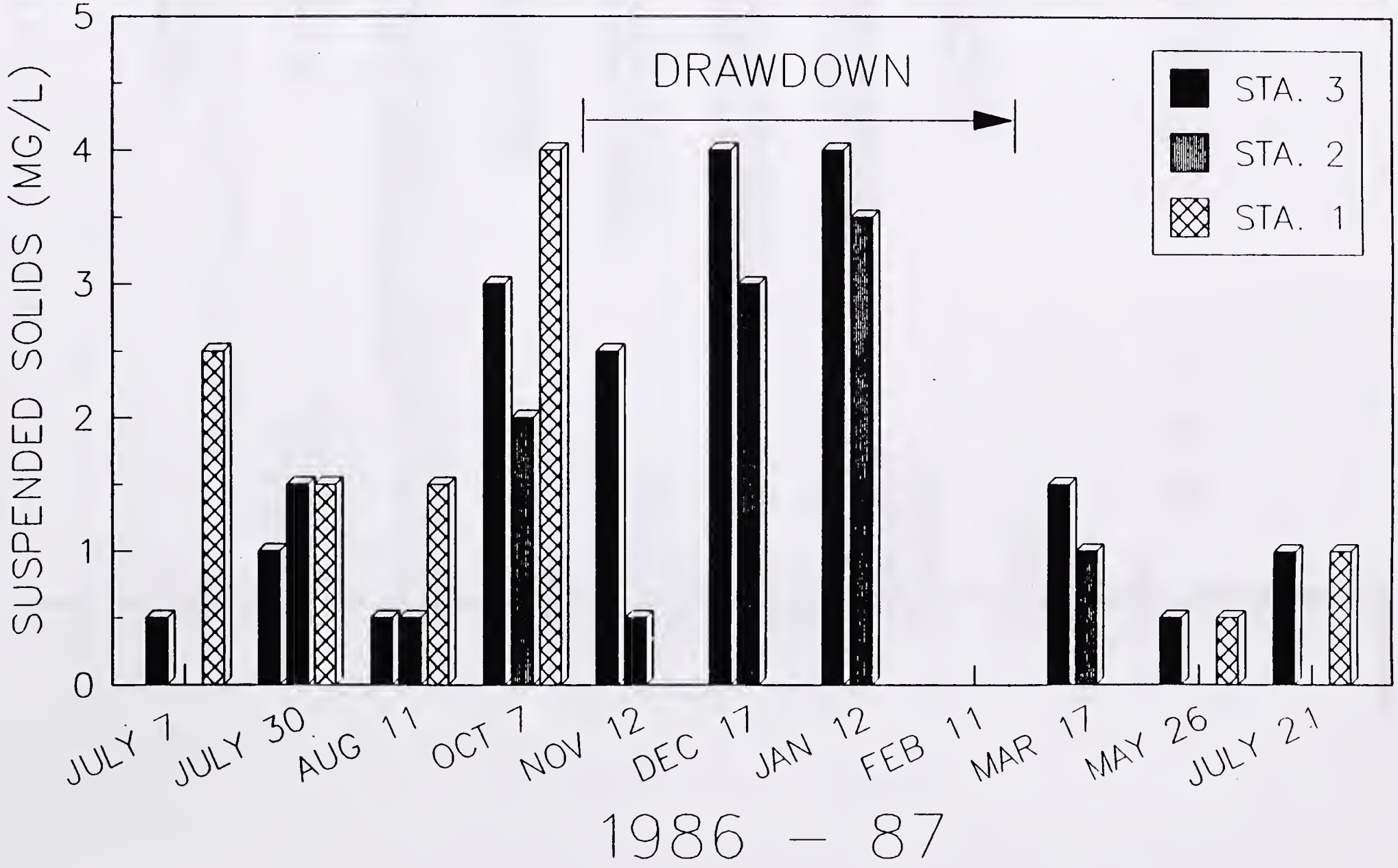


FIGURE 13
EFFECTS OF 1986–87 DRAWDOWN ON SUSPENDED SOLIDS



Program database that Lake Lashaway contributes an additional burden of suspended solids during annual drawdowns "that would exceed the recommended limits on the most sensitive receiving water use" (Massachusetts Surface Water Quality Standards, 1985).

There is little evidence also that lake drawdown contributed an additional burden of nutrients, particularly phosphorus, to the East Brookfield River. The range (0.05-0.08 mg/l) and mean (0.06 mg/l) concentrations of total phosphorus for the inlet and outlet were essentially identical during the 1984-85 drawdown and, for that matter, throughout the year of sampling depicted in Fig. 14. The close relationship of inflowing and outflowing total phosphorus on most dates is also evident in Figs. 15 and 16, which show sampling results for the winter drawdowns of 1985-86 and 1986-87. These results could indicate that Lake Lashaway does not serve as a sink for phosphorus due to its high flushing rate, but that cannot be stated with certainty since flow was not measured, total phosphorus loading was not derived for all sources, and there are other plausible explanations.

On a few dates the concentration of total phosphorus at Station 3 exceeded substantially that recorded for Station 2. The respective concentrations were 0.14 and 0.10 mg/l on December 23, 1985 (Fig. 15). At that time the lake had already been lowered by 8 feet to its maximum drawdown depth. Again, rainfall is the most likely explanation. The National Oceanic and Atmospheric Administration (1985) reported 0.38 inches of precipitation for the City of Worcester during the interval of December 22 and 23, and 0.34 inches for the town of Ware on December 23. In this instance local, rather than watershed, runoff likely accounts for the recorded differences in total phosphorus between stations. The high total phosphorus concentration (0.12 mg/l) in outflowing water on April 15, 1986 was twice that of Station 1 (including surface and 4 m depth samples) and three-fold higher than Station 2 (Fig. 15). This event occurred approximately 45 days after the lake was refilled, and at a time when the in-lake concentration of total phosphorus had reached equilibrium (Fig. 15). Since in-lake surface water was spilling over the outlet weir, and the outlet sample (Station 3) was collected on the lake side of the spillway, there is no logical explanation for the high concentration of total phosphorus recorded for Station 3 on April 15, 1986. Excluding the above exceptions, no excess phosphorus was discharged from Lake Lashaway as a result of winter drawdown (Appendix IX).

Only a small fraction (< 5%) of total phosphorus in the open water of lakes is available as a nutrient in the form of soluble orthophosphate (PO_4^{-3}); the only inorganic form that can be utilized by phytoplankton and other algae (Wetzel 1983). Typically, this nutrient most often controls the amount of plant production in lakes. Soluble orthophosphate is usually not analyzed in samples collected from routine water quality surveys because accurate results are difficult to obtain. Even when this difficulty is remedied the data only represent an instantaneous concentration, as turnover rates of this nutrient are "extremely rapid" (Wetzel 1983). The same is not true for nitrogen, another critical plant nutrient that can also limit production.

Nitrate and ammonia are soluble nutrient forms of nitrogen utilized by phytoplankton and other algae. They were both analyzed routinely in the Lake Lashaway Monitoring Program. Nitrate is the common, stable form of inorganic nitrogen, and its behavior in Lake Lashaway paralleled that of total phosphorus. Thus, during the drawdowns of 1984-85, 1985-86, and 1986-87 the concentrations of nitrate nitrogen in outflowing water (Station 3) were equal to or less than

FIGURE 14
EFFECTS OF 1984–85 DRAWDOWN ON TOTAL PHOSPHORUS

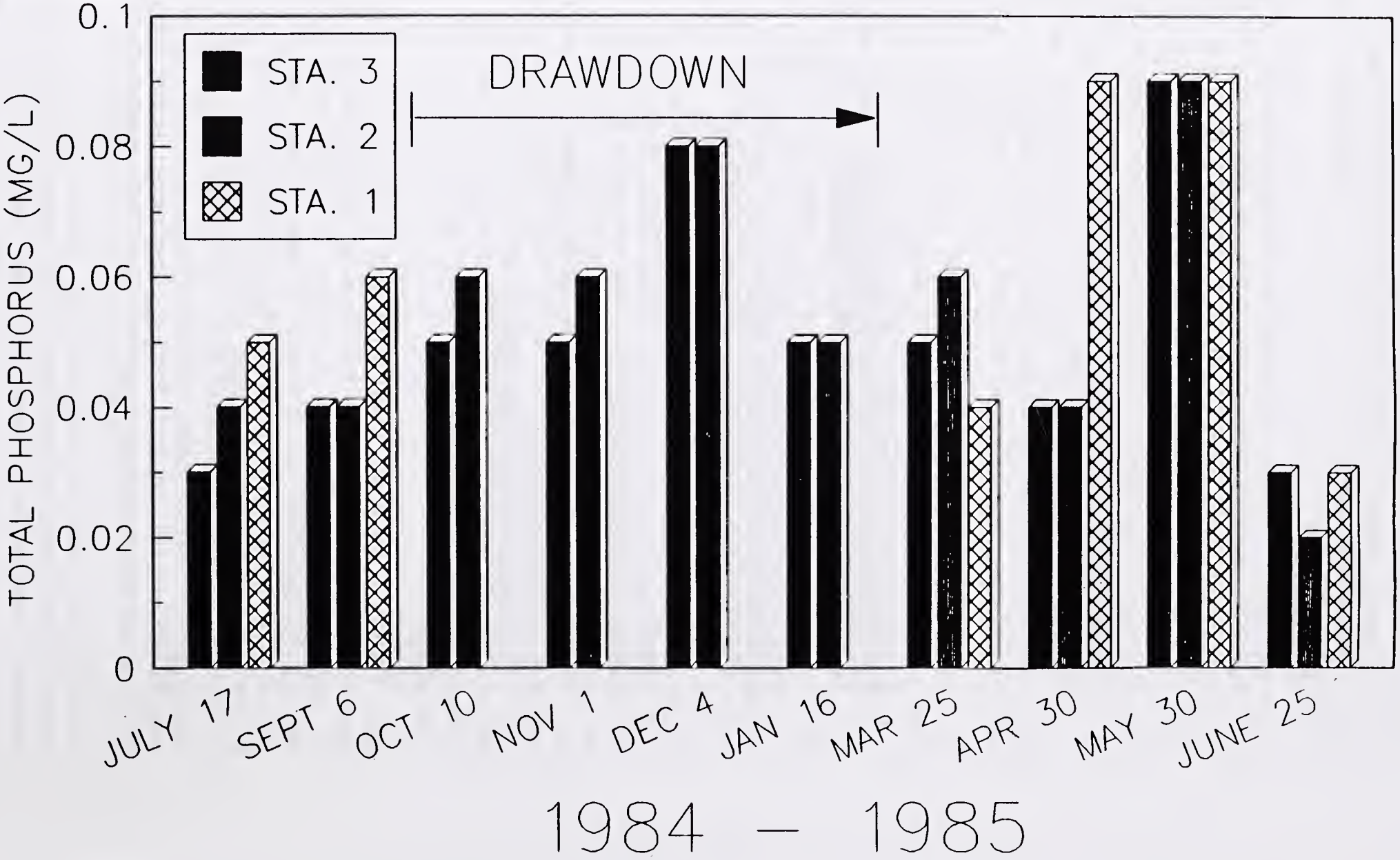


FIGURE 15
EFFECTS OF 1985–86 DRAWDOWN ON TOTAL PHOSPHORUS

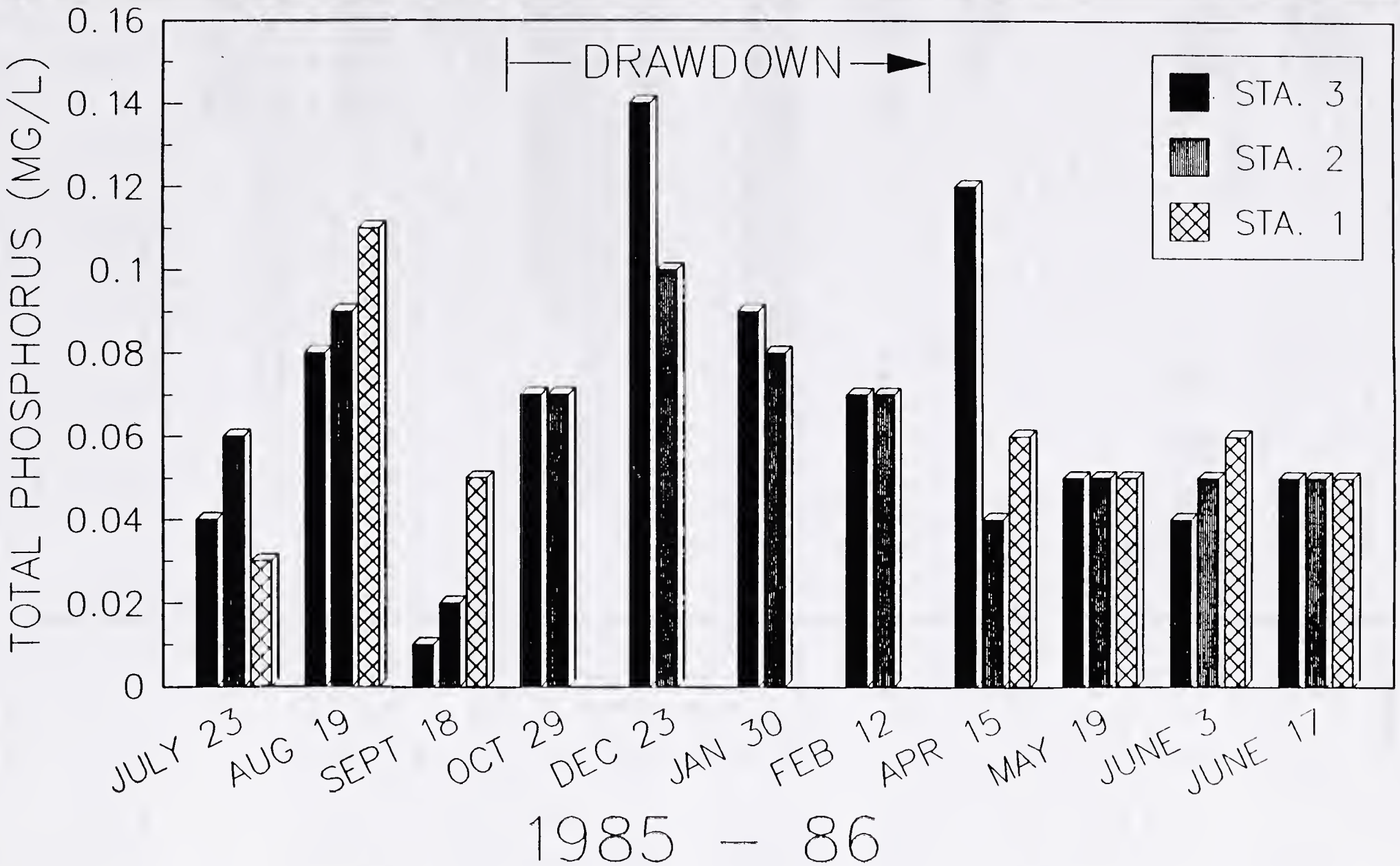
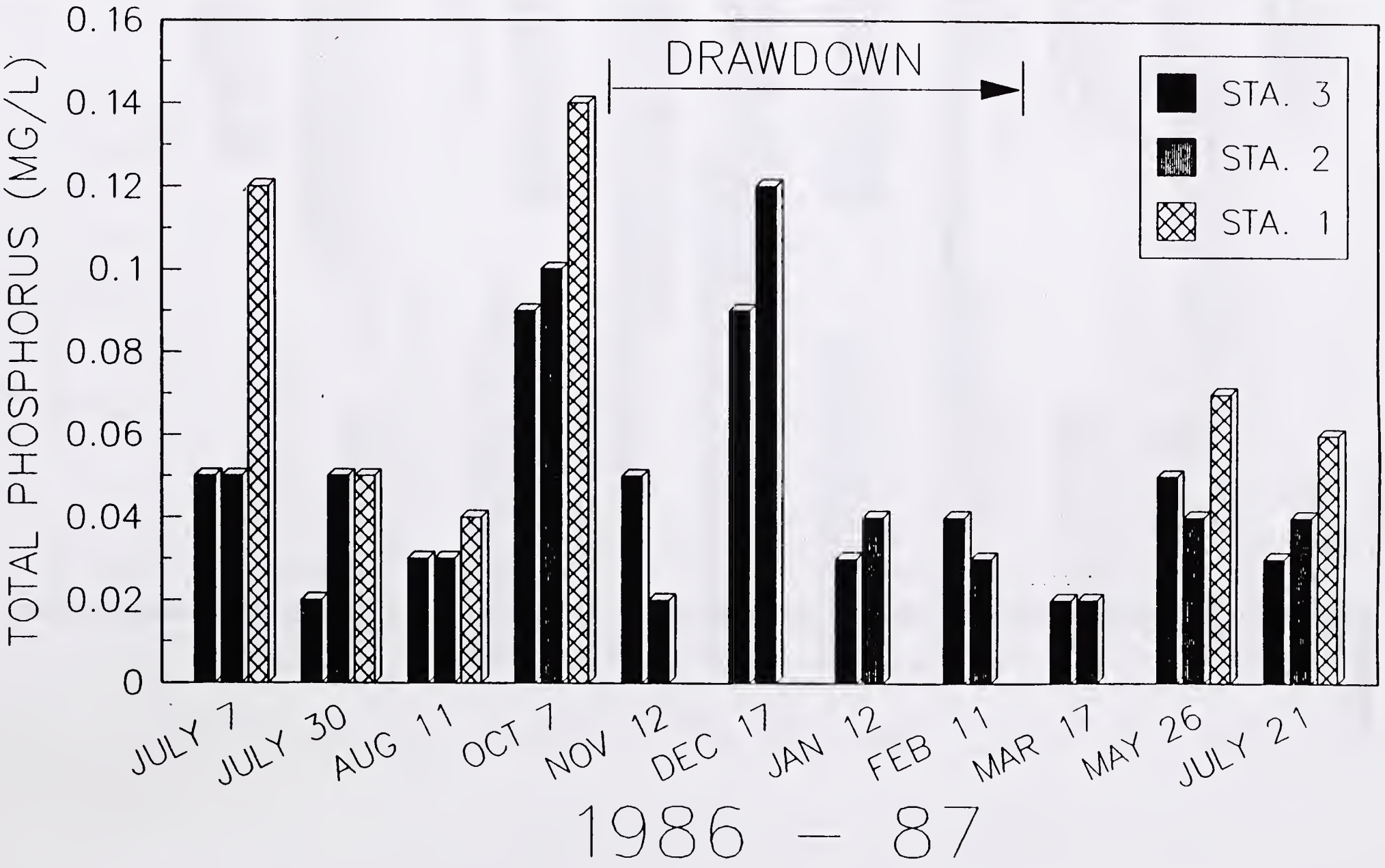


FIGURE 16
EFFECTS OF 1986–87 DRAWDOWN ON TOTAL PHOSPHORUS



that measured from inlet (Station 2) samples on all but two dates, October 10, 1984 and December 23, 1985 (Appendix IX). Ranges and means (in parentheses) for the inclusive period of all three winter drawdowns are <0.01-1.0 (0.31) mg/l at Station 3, and <0.01-0.5 (0.32) mg/l at Station 2. The nitrate nitrogen data prior to and following winter drawdowns are also remarkably similar for these two stations (Appendix IX). As discussed previously, antecedent rainfall likely influenced the higher concentrations recorded at Station 3 on October 10, 1984 and on December 23, 1985.

Ammonia nitrogen data are more variable. This form is utilized not only by plants as a nutrient, but also by nitrifying bacteria as their source of energy. Concentrations of ammonia nitrogen declined in outflowing lake water after the 1984-85 and 1985-86 drawdowns, whereas no change was evident between Stations 3 and 2 following the 1986-87 drawdown (Appendix IX). On some sampling dates Station 3 ammonia nitrogen exceeded that at Station 2; on other dates the opposite was true. This nutrient was consistently higher at Station 3 during the 1985-86 drawdown, a trend that was already evident prior to lowering the lake. Ranges and means (in parentheses) for all three drawdowns, inclusive, are 0.01-0.13 (0.06) mg/l at Station 3, and < 0.01-0.09 (0.05) mg/l at Station 2. There is, therefore, no unequivocal evidence that annual drawdowns caused the release of higher concentrations of ammonia nitrogen to the East Brookfield River.

IEP (1981) discussed the potential for increased nutrient loading, particularly nitrogen forms, to the East Brookfield River following annual drawdowns of Lake Lashaway. Their assessment that "nutrient loading will occur" with the "highest release of nutrients during the first two months after the lake is lowered" has not been realized.

Finally, as a point of clarification, and to reiterate a statement made previously in this section of the final report, the purpose of the Monitoring Program was "to assess potential adverse effects during construction of the outlet control structure as well as to determine the potential in-lake and downstream effects of repeated drawdowns." However, monitoring the potential impact of discharging a large volume of Lake Lashaway water and its natural load of solids and nutrients to the East Brookfield River and downstream waterbodies during annual drawdowns was not a special condition of any permit or certificate (Appendix V). The rates of drawdown and refill were specifically selected to avert such problems (IEP, 1981) and, as a consequence, no monitoring was conducted. A minor exception was the observation by Division of Water Pollution Control field crews that energy dissipators at the outfall of the drawdown culvert pipe effectively prevented scour and erosion of the East Brookfield River stream bed and west bank, as predicted by IEP (1981).

CONCLUSIONS

As evident in the results of the Monitoring Program described herein and the testimony provided by the Lake Lashaway Community Association, East Brookfield Board of Selectmen, and North Brookfield Board of Selectmen, the Section 314 Phase II Restoration Project of Lake Lashaway has been an unqualified success. Nuisance populations of Cabomba caroliniana and Najas flexilis have been decimated, and the lake is once again at its full potential for aesthetic and recreational enjoyment by the public. There have been no recorded or observed adverse effects of this restoration project on wetlands adjacent to the Fivemile

River upstream, and there is practically no evidence that excess suspended solids or nutrients were discharged from Lake Lashaway to the East Brookfield River as a consequence of Phase II construction or annual drawdown.

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APPENDIX I

Annotated Chronology of Lake Lashaway Restoration

APPENDIX I

Annotated Chronology of Lake Lashaway Restoration

March 22, 1978	Contract for a eutrophication study of Lake Lashaway executed by the Conservation Commissions of East Brookfield and North Brookfield, and Lycott Environmental Research Company of Sturbridge, Massachusetts.
January 31, 1979	Comprehensive Eutrophication Study of Lake Lashaway completed by Lycott Environmental Research Company. The first phase of this study was completed on June 30, 1978, at a cost of $3,276, which was paid by the Lake Lashaway Community Association. The towns of East Brookfield and North Brookfield each paid $3998 for the second phase of the study, which covered the period July to December, 1978. Thus, the total project cost was $11,272.
May 17, 1979	Lake Lashaway was one of nine lakes in Massachusetts funded for an aquatic nuisance control project under Chapter 722, the Eutrophication and Aquatic Vegetation Control Program administered by the Commonwealth's Division of Waterways.
July 26, 1979	A preapplication meeting was held to determine the steps and activities necessary for application of federal funds once regulations are promulgated for Section 314 grants. This was just one of many meetings that were subsequently convened for the purpose of discussing the Lake Lashaway project, and it included federal (Ronald Manfredonia and Warren Howard), state (Eben Chesebrough, Arthur Screpetis, and James Arnold), and local (Robert Munyon) representatives.
January 17, 1980	The towns of East Brookfield and North Brookfield executed a contract with IEP, Inc. of Wayland, Massachusetts to complete the following scope of services as a component of the Section 314 Phase I Assistance Agreement: a) design and engineering services for an outlet control structure; b) contract plans and specifications; c) permits; d) environmental assessment of Lake Lashaway drawdown; and e) a sanitary survey of the lake. Tasks a) to c) above were subcontracted to Greenman-Pedersen, Associates of Worcester, Massachusetts.

March 27, 1980

The U.S. EPA offered the Commonwealth's Division of Water Pollution Control a grant of financial assistance in the amount of $20,700 for the Phase I diagnostic/feasibility study of Lake Lashaway. The study included the following components: a) design plans for an outlet structure to facilitate an 8 foot drawdown; b) environmental assessment of the proposed drawdown; c) sanitary survey of houses abutting Lake Lashaway; and d) reimbursement to the towns of East Brookfield, North Brookfield, and the Lake Lashaway Community Association for 70% of the cost of the Comprehensive Eutrophication Study of Lake Lashaway.

Before any U.S. EPA grant funds could be disbursed to fund Phase I project elements, however, the Massachusetts Department of Environmental Quality Engineering had to develop a funding mechanism, or Substate Agreement. As a consequence, there was a delay of approximately 12 months before the towns of East Brookfield, North Brookfield, and the Lake Lashaway Community Association were reimbursed for the Comprehensive Eutrophication Study of Lake Lashaway. Funding of other project elements was delayed as well.

April 22, 1980

By a letter dated April 22, 1980 the Governor of the Commonwealth designated the Department of Environmental Quality Engineering, Division of Water Pollution Control as the Massachusetts agency for cooperative agreements with the U.S. EPA Clean Lakes Program.

June 12, 1980

The U.S. EPA approved an amendment to the Phase I Diagnostic/Feasibility Study cooperative agreement for an additional $3500. This action raised the total project cost to $34,572 and the federal share to $24,200.

June 21, 1980

IEP, Inc. of Wayland, Massachusetts was authorized by the Conservation Commissions of East Brookfield and North Brookfield to implement a sanitary survey of cottages/houses abutting Lake Lashaway. IEP, Inc. conducted the sanitary survey during the interval July 9 to 11 (IEP, 1980). Seventy percent (70%) of the total cost of the Sanitary Survey was funded as part of the Phase I grant award.

August 31, 1980

The Massachusetts Division of Fisheries and Wildlife completed their Survey Report of Lake Lashaway, which included a "Fish Stock Assessment" and "Recommendations for Management."

November 17, 1980	The Boards of Selectmen of East Brookfield and North Brookfield met jointly and they voted unanimously that East Brookfield would be the grantee for the Lake Lashaway restoration project and that Charles Abysahl (Commissioner of Buildings) would be the grantee's Administrator/Agent.
February 4, 1981	The U.S. EPA approved the Section 314 Assistance Agreement for the Phase II Restoration Project of Lake Lashaway in the amount of $103,800 (federal share), or 50% of the total estimated project cost. The project entailed design and construction of an outlet structure to facilitate an 8 foot winter drawdown; design and construction of a retention dam at the lake inlet; and a one-year monitoring program.
March 2, 1981	At a special town meeting, East Brookfield voters unanimously approved three articles to accept and expend funds made available by the U.S. EPA and the Commonwealth of Massachusetts for the Lake Lashaway project, and to enter into an intermunicipal agreement with the town of North Brookfield.
March 9, 1981	Also at a special town meeting, North Brookfield voters approved three articles pertaining to the Lake Lashaway project, including the intermunicipal agreement noted above. The Boards of Selectmen of East Brookfield and North Brookfield executed the intermunicipal agreement for the Phase I diagnostic/feasibility study of Lake Lashaway.
March 20, 1981	The U.S. EPA approved an amendment to extend the budget period and project period of the Phase I Diagnostic/Feasibility Study from April 1, 1981 to September 1, 1981.
March 27, 1981	DEQE Commissioner Anthony D. Cortese signed the Phase I Substate Agreement, which completed the execution of this novel arrangement for making funds available to substate agencies (in this instance the town of East Brookfield) by transferring to them funds provided by the U.S. EPA Clean Lakes Program.
March 31, 1981	DWPC Director Thomas C. McMahon mailed a "Notice to Proceed" with the scope of services required in the Substate Agreement to Charles Abysahl, Administrator/Agent for the Phase I Study.
June 25, 1981	The U.S. EPA approves an amendment to the Phase II Restoration Project of Lake Lashaway in the amount of $95,000 (federal portion) for the purpose of construction costs.

August 3, 1981	The U.S. Department of Agriculture, Soil Conservation Service, agreed to provide technical assistance to complete the Lake Lashaway Watershed Water Quality Management Plan. Completion of this plan was a special condition (#3-c) of the Phase I grant from the U.S. EPA.
August 4, 1981	The Massachusetts Division of Water Pollution Control issued its approval of the Shoreline Sanitary Survey (IEP, 1980) as fulfilling the requirements of Scope of Work Task 1 in the Phase I Substate Agreement.
August 25, 1981	The Massachusetts Division of Water Pollution Control submitted three documents to the U.S. EPA in fulfillment of the Section 314 Phase I grant award. These documents included the Lake Lashaway Sanitary Survey Report prepared by IEP, Inc., the Lake Lashaway Drawdown Program - Outlet Design and Environmental Assessment Report also prepared by IEP, Inc., and contract documents for the construction of the culvert and outlet works at Lake Lashaway.
October 8, 1981	The U.S. EPA approved an amendment to extend the budget period and project period of the Phase I Diagnostic/Feasibility Study for October 15, 1981 to July 1, 1982.
October 13, 1981	David Adams (Senior Sanitary Engineer, Massachusetts Division of Water Pollution Control) was appointed state inspector for the Phase II Restoration Project at Lake Lashaway.
October 16, 1981	The U.S. EPA approves the Lake Lashaway Sanitary Survey Report, and the Drawdown Program - Outlet Design and Environmental Assessment Report as fulfilling special award conditions of the Section 314 Phase I grant.
March 3, 1982	The U.S. EPA provides final written approval of the completed Phase I diagnostic/feasibility study (letter from Warren K. Howard to Barbara R. Notini).
June 1, 1982	An Intermunicipal Agreement was executed by the towns of East Brookfield and North Brookfield, which was a prerequisite for state approval of the Section 314 Phase II Substate Agreement.
June 23, 1982	U.S. EPA approves an amendment to extend the budget period and project period of the Section 314 Phase II Restoration Assistance Agreement from March 1, 1983 to February 4, 1986.

July 1, 1982	Massachusetts Division of Water Pollution Control (DWPC) Director Thomas C. McMahon informed U.S. EPA Clean Lakes Coordinator Ronald G. Manfredonia that the Commonwealth's match for the Phase II Restoration Project amendment was derived from the newly established Chapter 628 Clean Lakes and Great Ponds Program.
July 1, 1982	U.S. EPA Clean Lakes Coordinator Ronald G. Manfredonia wrote that"... all outstanding grant conditions for release of federal funds" have been met and the "Commonwealth of Massachusetts is allowed to expend grant funds to implement the Section 314 Phase II Restoration Project of Lake Lashaway" (letter to DWPC Project Officer Michael T. Ackerman).
July 15, 1982	The Lake Lashaway Phase II Restoration Project Substate Agreement was executed by all parties thereto, and a "Notice to Proceed" was issued to the town of East Brookfield by DWPC Director McMahon.
August 2, 1982	DWPC Director Thomas C. McMahon gives approval to award the Section 314 Phase II construction management services contract to Greenman-Pedersen, Associates of Worcester, Massachusetts.
August 4, 1982	The Massachusetts Division of Water Pollution Control began a long-term monitoring program of the Phase II Restoration Project of Lake Lashaway. Pre-construction, construction, and post-construction monitoring included sample collection and measurements at the inlet, outlet, and main basin of Lake Lashaway.
August 10, 1982	On this date John A. Bewick, Secretary, Massachusetts Executive Office of Environmental Affairs, issued a Certificate stating that the Final Environmental Impact Report for the Lake Lashaway Drawdown Project and Outlet Construction "...does adequately and properly comply with Massachusetts General Laws... and the regulations implementing MEPA."
August 17, 1982	Contract executed between the town of East Brookfield and Greenman-Pedersen, Associates of Worcester, Massachusetts for construction management services to build a culvert and outlet works at the south end of Lake Lashaway. The "general fee" for the contract was $18,000.

August 17, 1982	Contract executed between the town of East Brookfield and Marois Brothers, Inc. of Worcester, Massachusetts for construction of the outlet works, control gate, culvert, and head wall east of the existing spillway at the south end of Lake Lashaway. Town issues "Notice to Proceed." The contract sum was $252,875. Note: during construction there were seven "change orders" that increased the construction cost by $21,364.35 (refer to Appendix VI).
September 1, 1982	Marois Brothers, Inc. began construction of the Lake Lashaway outlet structure.
November 17, 1982	The first meeting of the "Lake Lashaway Restoration Committee" was convened at the East Brookfield Municipal Building. Robert Munyon and Robert Barton were elected Committee Chairman and Secretary, respectively. Appointment of this Committee was specified in the Substate Agreement for both "short-term and long-term management of the project." One long-term responsibility of the Committee was to determine, on a yearly basis, when the lake would be lowered. Accordingly, one of the Committee's first actions was to designate Friday, November 19, 1982 as the ceremonial day for opening the newly constructed outlet control valve to initiate lake drawdown.
November 19, 1982	About 150 people "braved a cold northeast wind" to witness the official opening of the newly constructed outlet valve to begin the first, albeit partial, drawdown of Lake Lashaway. Bob Munyon and Charles Abysahl cranked open the valve. About the same number of people attended a testimonial dinner that evening in honor of Bob Munyon, who was presented a Senate Citation by Senator Robert D. Wetmore. Bob also received gifts "from the people" for his tireless efforts to bring the drawdown project to fruition.
March 1, 1983	Marois Brothers, Inc. completed construction on the Lake Lashaway outlet structure with the exception of site restoration.
June 16, 1983	At a special town meeting, East Brookfield voters passed a motion to borrow a sum of money not to exceed $50,000 for the Lake Lashaway Phase II Project by a vote of "49 in favor and 1 opposed."
December, 1983	David A. Robinson Contracting of Barre, Massachusetts constructed the check dam across the Fivemile River south of the Harrington Street bridge. The total cost of construction was $7,218.

April 25, 1984	All construction for the Section 314 Phase II Restoration Project of Lake Lashaway had been completed. Both the outlet structure and the upstream check dam were 100 percent operational. Individuals representing the U.S. EPA (Warren Howard and William Butler), the Massachusetts Department of Environmental Quality Engineering, Division of Water Pollution Control (Eben Chesebrough and Michael Ackerman), and the Lake Lashaway Community Associates (Robert Munyon) inspected the project construction sites. All of these individuals concurred that the construction was satisfactory.
October 1984	The first complete 8 foot drawdown of Lake Lashaway was initiated in October. Both the outlet structure and upstream check dam performed as designed. Limited drawdowns were allowed during the previous two winters prior to the construction of the check dam.
February 1985	The first refilling of Lake Lashaway following a complete winter drawdown was initiated in February. The lake was successfully refilled prior to the March 1 deadline, and the flash boards were subsequently removed from the upstream check dam to allow unimpeded migration of spawning fish populations.
September 9, 1985	The Substate Agreement for the Section 314 Phase II Restoration Project of Lake Lashaway was formally terminated by the Division of Water Pollution Control and the town of East Brookfield due to the timely completion of the project scope of work and full reimbursement of funds to the grantee.
January 1986	The Commonwealth of Massachusetts, through its Department of Environmental Quality Engineering, funded a separate Phase II project (No. 628-84-14) to dredge sediments from the northern cove of Lake Lashaway. A grant of $37,500, or 75% of the total estimated project cost, was awarded to the town of North Brookfield through the Department's Clean Lakes and Great Ponds Program. J.D. Contracting, Inc. of East Longmeadow, Massachusetts removed 18,036 cubic yards of sediment during January and February, 1986.
March 11, 1987	The U.S. EPA approved an amendment to extend the budget period and project period of the Section 314 Phase II Restoration Project Assistance Agreement from February 4, 1986 to March 1, 1988.
July 6, 1988	The Massachusetts Division of Water Pollution Control, Technical Services Branch completed its six-year monitoring program of the Lake Lashaway Phase II Restoration Project.

January 5, 1989	The U.S. EPA approved an amendment to extend the budget period and project period of the Section 314 Phase II Restoration Project Assistance Agreement from March 1, 1988 to June 30, 1989.

APPENDIX II

Ronald G. Manfredonia Letter of May 8, 1979

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION I
J.F. KENNEDY FEDERAL BUILDING, BOSTON, MASSACHUSETTS 02203

Bob Munyon

May 8, 1979

Mr. Robert E. Munyon
President
LAKE LASHAWAY COMMUNITY
ASSOCIATION
Shore Road
North Brookfield, MA 01535

Dear Mr. Munyon:

In response to your letter of April 30, 1979, I would like to clarify our position on the Lake Lashaway diagnostic-feasibility study.

To complete the feasibility portion of the study for the Lake Lashaway project, the following should be included:

1. Detailed engineering plans and a cost-breakdown of the drawdown structure and the associated environmental impacts. The cost breakdown should include administration, engineering design, and construction costs associated with the implementation of this project.

2. A comprehensive lake watershed management program. Consideration should be made of the consultant's recommendations in the completed diagnostic study.

3. A monitoring program to access the impact of drawdown.

In regard to the funding situation, the total cost of the feasibility study and the previously completed eutrophication study would be funded at a matching of 70% federal and 30% grantee. This assumes finalization of the proposed regulations as written.

In other words, 70% of the funds utilized in the development of the eutrophication study would be reimbursed to you. A second application meeting conditions 1, 2, and 3 could then be submitted for federal funding.

The possibility for success of this project appears to be very high. We would recommend that the Lake Lashaway Association continue to pursue this project to completion.

Sincerely yours,

Warren K. Howard

for Ronald G. Manfredonia
Water Quality Branch

cc: Senator Wetmore
Representative Grenier
Arthur Screpetis, MDWPC
Mario Boschetti, DEQE

APPENDIX III

Intermunicipal Agreement for Construction

INTERMUNICIPAL AGREEMENT FOR CONSTRUCTION

Agreement made this 1st day of June, 1982 by and between the Town of North Brookfield, Massachusetts and the Town of East Brookfield, Massachusetts.

Whereas, the great and general Court of the Commonwealth has enacted Chapter 40, Section 4A of the General Laws allowing local communities to enter into joint agreements for undertakings which each contracting unit is authorized by law to perform, and

Whereas, the United States Environmental Protection Agency (the "EPA") has awarded the Massachusetts Department of Environmental Quality Engineering Division of Water Pollution Control ("DEQE") a cooperative agreement for the construction of a water supply line and construction of a culvert under Route 9 at Lake Lashaway which authorizes the DEQE to enter into a substate agreement for all or a portion of the work required under said Cooperative Agreement, and

Whereas, said substate agreement is to be executed by the Town of East Brookfield only, but would require appropriation of funds and effect the interests of both the towns of East Brookfield and North Brookfield, and

Whereas, the towns of East Brookfield and North Brookfield wish to enter into an agreement between themselves concerning their conduct, rights and obligations under said substate agreement, and

Whereas, the towns of East Brookfield and North Brookfield, by prior town meeting votes, have authorized their respective Boards of Selectmen to execute on behalf of the towns said agreement.

Now, therefore, the towns of East Brookfield and North Brookfield do mutually agree as follows:

1. East Brookfield shall apply for, accept, receive, manage and expend without further appropriation funds which may be made available through federal and state agencies, together with all funds received from North Brookfield and funds appropriated by East Brookfield in compliance with the terms and conditions of the substate agreement with the DEQE concerning Lake Lashaway, executed 6-14-82.

2. North Brookfield shall transfer to East Brookfield all funds which have been appropriated for said water supply line and construction of a culvert under Route 9 at Lake Lashaway for use with other funds in accordance with the terms and conditions of the said substate agreement.

3. East Brookfield shall undertake the work described in the said substate agreement in accordance with the terms and conditions thereof.

4. East Brookfield shall consult on a regular basis with North Brookfield concerning the progress of all work performed.

5. East Brookfield and the contractors and subcontractors shall not execute, amend or terminate any contracts for work done concerning said substate agreement without the pre-written approval of North Brookfield.

6. East Brookfield shall comply with all statutes, regulations and executive orders pertaining to the award of public contracts.

7. The Board of Selectmen of each of the parties shall be responsible for the implementation of this agreement, and shall receive all notices hereunder, unless an agent or agents are appointed by mutual agreement of both towns.

8. This agreement may be amended by mutual consent of the parties. Such changes or additions when mutually agreed upon shall be incorporated in this agreement by mutual amendments executed in the same manner as this agreement.

9. This agreement shall remain in effect until terminated by all the parties hereto upon written notice setting forth the date of such termination.

In witness whereof, the parties hereto have executed this agreement as of the date first written above.

Board of Selectmen
of North Brookfield

Board of Selectmen
of East Brookfield

APPENDIX IV

Design Drawings for Outlet Control Structure

SEE INTAKE DETAIL SHEET 4

OUTLET

inv 613.00

614.0

614

rip rap

350.35

S 70°53'43"E

sidewalk

bituminous

620.3

620.5

6200

48" CULVERT

CB

rim 619.4
inv. 616.44
sump 615.2

148+00

6202

16" DUCTILE IRON PIPE

620.6

147+50

47'-12" R.C.P. - 3.7 %

12" WATER MAIN

PIPE 619.84
INV. 616.76
SUMP 615.26 CB

620.3

620.9

620.8

620.1

620.7

Bitumious

concrete

sidewalk

620.2

620.82

Valve

618.2

613.8

619.4

603.84

500.00

L=194.75

620.0

618.0

616.0

603.4

612.8

16"

inv 612.58 8" hickory

6" birches

L 8" MASONRY
IN 12" PIPE
ABANDONED

inv. 605.6

609.7

602.4

inv. 602.08

RESTORE RIP RAP
ORIGINAL CONDITION

611.0

610.5

610.0

HEADWALL

601.8

PROJECT LOCATION

Lake Lashaway

Sevenmile

East Brookfield

N

LOCATION PLAN

WILLIAM C. BROOKFIELD
No. 29925
REGISTERED PROFESSIONAL ENGINEER

William C. Brookfield
(civil)

			PSU
ON	BY	CHKD	APP

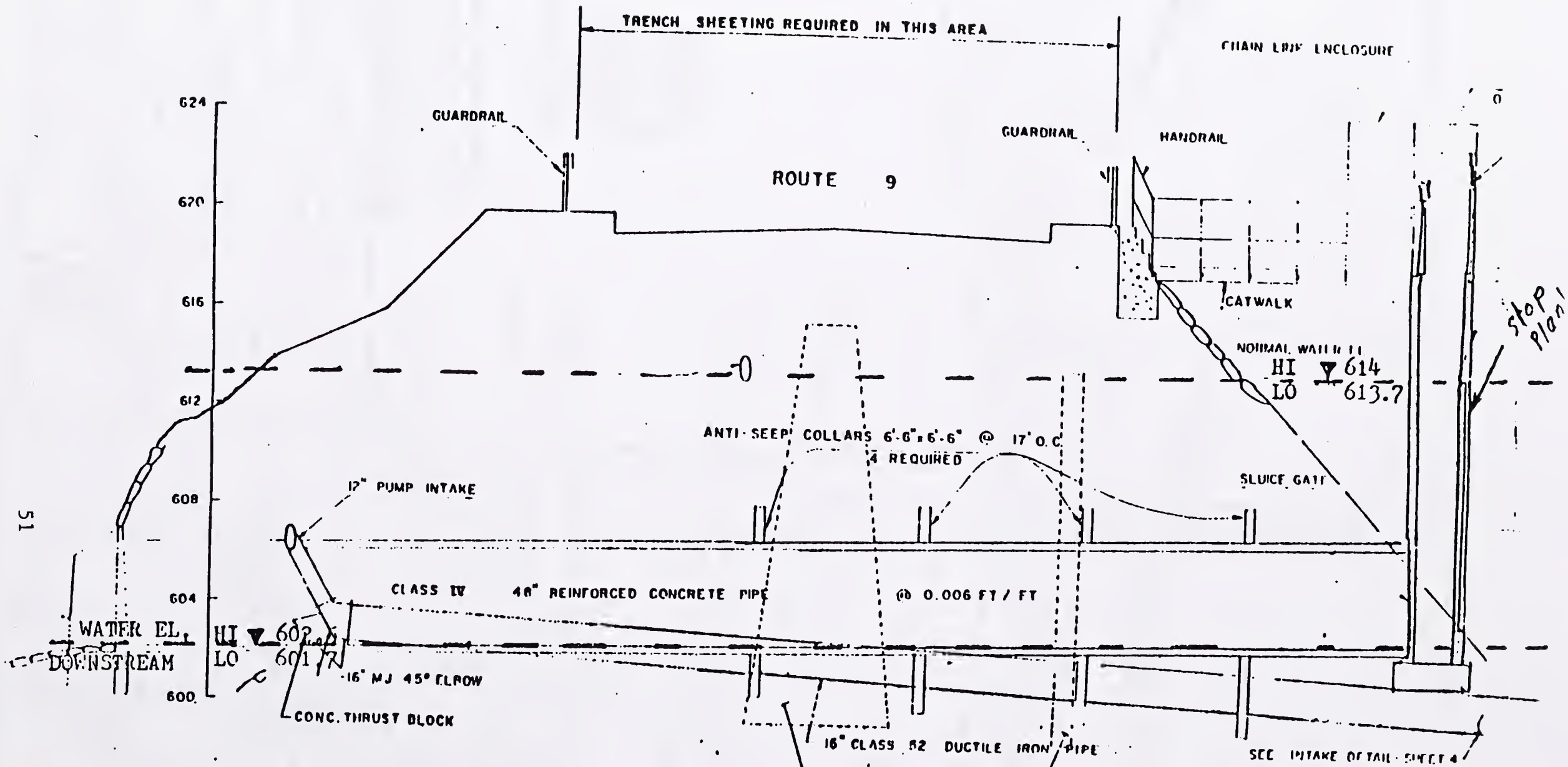
DATE	PROJECT NO	DRAWING NO
APRIL, 1980	79206	79206 - 1

EAST BROOKFIELD, MASSACHUSETTS

LAKE LASHAWAY OUTLET STRUCTURE

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
LANG N V	W C. B.	P A V	10

GREENMAN-PEDERSEN, ASSOCIATES
CONSULTING ENGINEERS
WORCESTER MASSACHUSETTS



WILLIAM C. BOUCHARD
(CIVIL)

PROFILE

SCALE HORZ. 1" = 10'-0"
VERT. 1" = 4'-0"

DATE	PROJECT NO	DRAWING NO
APRIL, 1980	79206	79 206 - 2

EAST BROOKFIELD, MASSACHUSETTS

LAKE LASHAWAY OUTLET STRUCTURE

DRAWN BY	REVIEWED BY	APPROVED BY	SCALE
LANG N. V.	W C B	R A.V.	AS SHOWN

GREENMAN-PEDERSEN, ASSOCIATES

APPENDIX V

Permits and Certificates

APPENDIX V

Permits and Certificates

May 7, 1980	Road cut Permit #3-11434 issued to town of East Brookfield by the Massachusetts Department of Public Works, subject to stated conditions and restrictions, to lay a forty-eight inch concrete pipe across Route 9 as a component of the outlet control structure.
January 22, 1982	The Massachusetts Division of Waterways determined that Lake Lashaway is not a Great Pond and that a Chapter 91 License was not required for construction of the outlet structure.
January 27, 1982	The East Brookfield Conservation Commission issued its Order of Conditions for constructing the outlet structure pursuant to Chapter 131, Section 40 of the Massachusetts General Laws.
February 14, 1982	The North Brookfield Conservation Commission issued its Order of Conditions for constructing the check dam south of the Harrington Street bridge pursuant to Chapter 131, Section 40 of the Massachusetts General Laws.
March 12, 1982	The Massachusetts Division of Waterways further determined that a permit under Chapter 253 (Small Dams Act) was not required for construction of the outlet control structure.
August 10, 1982	John A. Bewick, Secretary, Massachusetts Executive Office of Environmental Affairs issued a certificate stating that the Final Environmental Impact Report for the Lake Lashaway Drawdown Project and Outlet Construction "does adequately and properly comply with Massachusetts General Laws, Chapter 30, Section 62-62H inclusive, and the regulations implementing MEPA."
October 4, 1982	The Department of the Army, Corps of Engineers issued Permit Number MA-EABR-82-310, with conditions, to the town of East Brookfield to construct the outlet structure as well as a temporary sandbag cofferdam across the Fivemile River pursuant to Section 404 of the Federal Water Pollution Control Act (P.L. 92-500).
September 23, 1983	The Department of the Army, Corps of Engineers, amended Permit Number MA-EABR-82-310, as requested by the town of East Brookfield, to allow construction of a concrete barrier with stop logs in lieu of the temporary sandbag cofferdam, and to allow lake drawdown to begin on September 20.

The Commonwealth of Massachusetts

Department of Public Works

100 Nashua Street, Boston 02114

Telephone 727-7204

Town of EAST BROOKFIELD (Date) May 7, 19 80

RECEIVED

JUN 5 1980

Freeman-Pedersen Assoc. P.C.
Worcester, MA 01605

From the Office of: Mass. Dept. of Public Works, 400 Belmont St., Worcester

To: Town of East Brookfield, North St., East Brookfield, Mass. 01515
ATT: Paul Coutemanche, Supt.

You may proceed with the work described in Permit# 3-11431* dated May 7, 1980 issued to you by this Department for work in the Town of EAST BROOKFIELD.

Please read carefully the instructions printed on the back of the Permit and note particularly those conditions which apply to the work authorized.

Your attention is also called to the time given for the completion of this work. If it should be desired to extend the time for doing the work or alter any of the conditions of the Permit, application for such changes should be made as soon as possible to this office.

Upon completion of the work outlined, please fill out the form given below, detach and mail to this office. (A sketch on the back of the form or on a separate sheet, showing the location of any structures installed, should be submitted. This sketch should show the relative position of the structure by measurements to definite points within the highway location.) *If the perforated notice is not returned, the liability assumed under the permit continues.*

* Before starting work on this permit, kindly contact Joseph V. Miele, Worcester Tel. 754-7204 Ext. 45, between 9 A.M. to 5 P.M.
JVM/jl (Foreman: A. Cornacchia)

Very truly yours,

District Highway Engineer.

Town of EAST BROOKFIELD (Date) 19

DISTRICT HIGHWAY ENGINEER
Worcester, MASS.

Dear Sir:

Please be advised that the work authorized under Permit # 3-11431 issued by the Massachusetts Department of Public Works was completed in accordance with all the requirements of the Department on .....

FOREMAN: A. CORNACCHIA

Signed .....

NOTE: UPON COMPLETION OF WORK, PLEASE RETURN THIS LOWER PORTION ONLY.
Town of East Brookfield, North St. East Brookfield, Mass. 01515
Att: Paul Coutemanche, Supt. Permit issued 5/7/80

NO. -11[illegible]

The Commonwealth of Massachusetts

DEPARTMENT OF PUBLIC WORKS

SHEET 1 of 2

PERMIT EAST BROOKFIELD

Subject to all of the terms, conditions and restrictions printed or written below, and on the reverse side hereof, permission is hereby granted to TOWN OF EAST BROOKFIELD, to enter upon the State Layout, in the Town of EAST BROOKFIELD, on the road known as Brookfield Road, Auto Route #9, for the purpose of installing a forty-eight inch (48") R.C. pipe across the roadway at approximately station 147+20.

One half of the roadway shall be opened at a time. One half of the pipe shall be installed before the other half. One way traffic shall be maintained at all times. When one way traffic prevails, uniformed traffic police shall be in attendance at the expense of the Grantee.

Attention is called to the clauses on the reverse side of this permit relating to the laying of pipes, conduit, etc.

Where the hardened surface of the roadway is disturbed all backfilling will be replaced with approved material mechanically tamped in six inch (6") layers and the top twenty inches (20") shall consist of only new selected gravel. After backfilling has been completed and sub-grades reestablished a two inch (2") bituminous concrete Type I temporary patch shall be installed and maintained by the grantee for a period of at least ninety (90) days.

The permanent patch will consist of a six inch (6") black base laid over the backfilled trench and allowing for a two inch (2") Bituminous Concrete Type I-1 surface.

The permittee should exercise extreme care to prevent damage to major roots systems of trees. In the event damage to the roots as determined by the Engineer is severe enough to cause the eventual death of a tree, it shall be removed and replaced by a new tree.

All drainage structures and work will be done in conformance with existing

(CONTINUED)

(SEE OTHER SIDE FOR ADDITIONAL CONDITIONS)

No work shall be done under this permit until the Grantee shall have communicated with and received instructions from the District Highway Engineer of the Department of Public Works, at

This permit shall be void unless the work herein contemplated shall have been completed before

Dated at this day of

Department of Public Works,

By

HMD-602

NO. -1124-

The Commonwealth of Massachusetts

SHEET 2 of 3

DEPARTMENT OF PUBLIC WORKS

PERMIT EAST BROOKFIELD

Subject to all of the terms, conditions and restrictions printed or written below, and on the reverse side hereof, permission is hereby granted to

(CONTINUED)

Department Standard.

Upon completion of the permanent patch the surface treatment shall consist of Bituminous Concrete surface, machine laid. In the case of longitudinal trenches a surface treatment of three quarters inch (3/4") shall be placed from the crown line to the gutter line if trench is offset from centerline of road. If not, entire width shall be surface treated. In the case of a transverse trench, the surface treatment shall extend thirty feet (30') beyond the limits of each edge of the trench variable in depth from three quarter inch (3/4") to half inch (1/2").

Necessary barriers, signs and bomb lighting shall be provided by the Grantee conforming to the Department Manual Uniform Standard Traffic Control Devices. If a snow or ice condition exists during the progress of the work, the Grantee shall keep the roadway well sanded to a point not less than two hundred feet (200') beyond the limits of the barriers and signs.

All grassed areas where disturbed shall be restored to as good condition as found by loaming and seeding.

Care shall be exercised to protect existing underground structures.

The bounds marked MHB shall not be disturbed or buried.

All street approaches and driveways where disturbed shall be replaced conforming to original alignment, grade and materials.

(CONTINUED)

(SEE OTHER SIDE FOR ADDITIONAL CONDITIONS)

No work shall be done under this permit until the Grantee shall have communicated with and received instructions from the District Highway Engineer of the Department of Public Works, at

This permit shall be void unless the work herein contemplated shall have been completed before

Dated at this day of

Department of Public Works,

By

The Commonwealth of Massachusetts

SHEET 3 of 3

DEPARTMENT OF PUBLIC WORKS

PERMIT EAST BROOKFIELD

Subject to all of the terms, conditions and restrictions printed or written below, and on the reverse side hereof, permission is hereby granted to

(CONTINUED)

The Grantee shall exercise this permit subject to all the rules and regulations made from time to time by the said Department of Public Works and the Department of Public Utilities and nothing in the permit shall be construed as authorizing any installation or maintenance thereof except in strict conformity with all Federal, State and Municipal laws, ordinances and regulations.

The Grantee shall indemnify and save harmless the Commonwealth and its Department of Public Works against all suits, claims or liability of every name and nature arising at any time out of or in consequence of the Acts of the Grantee in the performance of the work covered by this permit and/or failure to comply with the terms and conditions of this permit whether by itself or its employees or sub-contractors.

A copy of this permit will be made available at the project site at all times during the progress of the work for inspection by Department Personnel. Should the Grantee or contractor not have a copy at the site, the work will be stopped until such permit is made available.

This office will be notified twenty-four (24) hours prior to the Start of Work under the provisions of this permit.

ALL OF SAID WORK SHALL BE DONE AS DIRECTED BY AND TO THE SATISFACTION OF THE ENGINEER FROM THIS DEPARTMENT.

(SEE OTHER SIDE FOR ADDITIONAL CONDITIONS)

No work shall be done under this permit until the Grantee shall have communicated with and received instructions from the District Highway Engineer of the Department of Public Works, at 403 Belmont St., Worcester, Mass., 754-7204

This permit shall be void unless the work herein contemplated shall have been completed before MAY 7, 1981

Dated at WORCESTER **this** 7th **day of** MAY, 1980

JVM/jl
C - LTP
A. Cornacchia

Department of Public Works,

By _____
DISTRICT HIGHWAY ENGINEER

HMD-602

Conditions Relating Particularly to Permits for the Laying of Pipes, Conduits, etc.

After any pipes, conduits, drains or other underground structures are laid, or any excavation is made in the roadway, the trenches or openings shall be properly back filled with suitable material, the back-filling shall be thoroughly tamped, and the surface of the road over said structures shall be left even with the adjoining ground. If the work is done in cold weather no frozen material shall be used for back-filling.

Wherever the hardened surface of the roadway gutters, or any part of the surface of the highway is disturbed it shall be replaced in as good condition as before it was disturbed, and if new materials are required they shall correspond with those already in place on the road.

Where service pipes are to cross the highway the connections shall be made without disturbing the hardened surface of the roadway, by driving the pipes under the roadway, or the service pipes shall be carried under and across the road in a larger pipe, unless otherwise ordered by the Engineer.

The Grantee shall maintain the surface of the roadway over said structures as long as the Department may deem necessary, until all signs of the trenches shall have been eliminated.

Conditions Relating Particularly to Permits for the Erection of Poles, Wires, and Overhead Structures, and the Cutting and Trimming of Trees

In the erection of pole lines, unless otherwise herein provided, no trees located within the limits of the State highway shall be cut or trimmed. No guy wires shall be attached to trees without a special permit from the Department, and in no event shall they be so attached as to girdle the trees or in any way interfere with their growth. The wires shall be so protected at all times and places that they shall not interfere with or injure the trees either inside or outside the location of the highway.

Where the cutting or trimming of trees is authorized by this permit, only such cutting and trimming shall be done as may be designated by the Engineer.

In the construction or reconstruction of pole lines no guy wires shall be erected nearer to the surface of the ground than six feet; provided, however, that the owners of such lines may maintain such guy wires at a lower elevation than six feet from the ground until such time as the Department shall notify them to remove said wires or to raise them to the elevation first stated.

In order to protect the trees through which any wires may pass, said wires shall be insulated and such other tree guards used as may be directed by the Engineer.

Where high tension wires are erected under this permit, they shall be so located that, under conditions of maximum severity as regards a coating of ice or snow, there shall be a space of at least eight feet between such high tension wires and other wires.

The Grantee shall, within sixty days from the date of completion of the work, file in the office of the Department a plan showing the location of each pole erected in accordance with the permit, said plan to be of such size and in such form as the Department may direct.

General and Additional Conditions

Whenever the word "Department" is used herein it shall mean the Department of Public Works of the Commonwealth of Massachusetts.

Whenever the word "Engineer" is used herein it shall mean the District Highway Engineer or other authorized representative of the Department.

Wherever the word "Grantee" is used herein it shall mean the person or persons, corporation or municipality to whom this permit is granted, or their legal representatives.

During the progress of the work all structures under ground and above ground shall be properly protected from damage or injury; such barriers shall be erected and maintained as may be necessary for the protection of the traveling public; the same shall be properly lighted at night; and the Grantee shall be responsible for all damages to persons or property due to or resulting from any work done under this permit.

Except as herein authorized, no excavation shall be made or obstacle placed within the limits of the State highways in such a manner as to interfere unnecessarily with the travel over said road.

If any grading or sidewalk work done under this permit interferes with the drainage of the State highway in any way, such catch basins and outlets shall be constructed as may be necessary, in the opinion of the Engineer, to take proper care of said drainage.

Wherever the hardened surface of the roadway is disturbed and the Engineer may consider it necessary or advisable to do so, said surface will be restored by the employees of the Department, at such time as the Department may direct, and the expense thereof shall be borne by the Grantee, who shall purchase and deliver on the road the materials necessary for said work if and when directed by the Engineer. All payments to materialmen and to laborers, inspectors, etc., employed by the Department for or on account of the work herein contemplated shall be made by said Grantee forthwith on the receipt of written orders, pay rolls, or vouchers approved by the Department.

IF THE GRANTEE DOES ANY WORK CONTRARY TO THE ORDERS OF THE ENGINEER, AND, AFTER DUE NOTICE, FAILS TO CORRECT SUCH WORK OR TO REMOVE STRUCTURES OR MATERIALS ORDERED TO BE REMOVED, OR FAILS TO COMPLETE WITHIN THE SPECIFIED TIME THE WORK AUTHORIZED BY THIS PERMIT, THE DEPARTMENT MAY, WITH OR WITHOUT NOTICE, CORRECT OR COMPLETE SUCH WORK IN WHOLE OR IN PART, OR REMOVE SUCH STRUCTURES OR MATERIALS, AND THE GRANTEE SHALL REIMBURSE THE COMMONWEALTH FOR ANY EXPENSE INCURRED IN CORRECTING AND/OR COMPLETING THE WORK OR REMOVING THE STRUCTURES OR MATERIALS.

ALL OF THE WORK HEREIN CONTEMPLATED SHALL BE DONE UNDER THE SUPERVISION AND TO THE SATISFACTION OF THE DEPARTMENT OF PUBLIC WORKS, AND THE ENTIRE EXPENSE THEREOF SHALL BE BORNE BY THE GRANTEE.

On the completion of the work herein contemplated all rubbish and debris shall be removed and the roadway and roadsides shall be left neat and presentable and satisfactory to the Engineer.

The Department hereby reserves the right to order the change of location or the removal of any structure or structures authorized by this permit at any time, said change or removal to be made by and at the expense of the Grantee or its/their successors or assigns.

This permit may be modified or revoked at any time by the Department without rendering said Department or the Commonwealth of Massachusetts liable in any way.

The Grantee shall pay the salary, subsistence and traveling expenses of any inspector appointed by the Department to supervise the work herein contemplated.

All of the above conditions shall be applicable to the work herein authorized, unless the same are inconsistent with the conditions on the face of the permit, in which case the conditions written or printed on the face of the permit shall apply.

The acceptance of this permit or the doing of any work thereunder shall constitute an agreement by the Grantee to comply with all of the conditions and restrictions printed or written herein.

ANTHONY D. CORTESE, Sc. D.
Commissioner

The Commonwealth of Massachusetts

Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Waterways
ONE Winter Street, Boston 02108

January 22, 1982

Mr. Blaise P. Berthiaume
185 Main Street
Spencer, MA 01562

Dear Mr. Berthiaume:

Please be advised that based upon further examination of information contained in this Department's files, it has been determined that Lake Lashaway is not a Great Pond (a pond of 10 acres or more in a natural state) and therefore a Chapter 91 License will not be required for said outlet structure.

This determination supersedes our letter of January 12,1982.

Very truly yours,

John J. Hannon, P.E.
Chief Engineer

cc: Army Corps of Engineers
East Brookfield Conservation Commission
D.E.Q.E. Region II
Barbara R. Notini WPC

MH
MH/ds

16.17

FORM 4
ORDER OF CONDITIONS
WETLANDS PROTECTION ACT
G.L. CH. 131 § 40

CITY/TOWN East Brookfield, Ma., 01515 FILE NUMBER _____

TO: NAME Board of Selectmen R Bain ADDRESS Conservation Commission

CERTIFIED MAIL NUMBER _____ H Blaisdell Depot Square

PROJECT LOCATION: L Petruzzi East Brookfield, Ma., 0

Address South end of Lake Lashaway, Route 9, East Brookfield, Ma.

Recorded at Registry of January 11, 1982 By Attny Berthiaume, Book _____, Page _____

Certificate (if registered) _____

REGARDING:

Notice of Intent dated October 1, 1981

and plans titled and dated Construction of a culvert and Outlet Works

THIS ORDER IS ISSUED ON (date) January 27, 1982

Pursuant to the authority of G.L. c. 131, § 40, the Conservation Commission has reviewed your Notice of Intent and plans identified above, and has determined that the area on which the proposed work is to be done is significant to one or more of the interests listed in G.L. c. 131, § 40. The Conservation Commission hereby orders that the following conditions are necessary to protect said interests and all work shall be performed in strict accordance with them and with the Notice of Intent and plans identified above except where such plans are modified by said conditions.

CONDITIONS

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this order.

2. This order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.

3. This order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state or local statues, ordinances, bylaws and/or regulations.

4. The work authorized hereunder shall be completed within one (1) year from the date of this order unless it is for a maintenance dredging project subject to Section 5(9). This order may be extended by the issuing authority for one or more additional one-year periods upon application to the said issuing authority at least thirty (30) days prior to the expiration date of the order or its extension.

5. Any fill used in connection with this project shall be clean fill, containing no trash, refuse, rubbish or debris, including, without limiting the generality of the foregoing, lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles or parts of any of the foregoing.

6. No work may be commenced until all appeal periods have elapsed from the order of the Conservation Commission or from a final order by the Department of Environmental Quality Engineering.

7. No work shall be undertaken until the final order, with respect to the proposed project, has been recorded in the Registry of Deeds for the district in which the land is located within the chain of title of the affected property. The Document number indicating such recording shall be submitted on the form at the end of this order to the issuer of this order prior to commencement of work.

8. A sign shall be displayed at the site not less than two square feet or more than three square feet bearing the words, "Massachusetts Department of Environmental Quality Engineering Number 149-9".

9. Where the Department of Environmental Quality Engineering is requested to make a determination and to issue a superseding order, the Conservation Commission shall be a party to all agency proceedings and hearings before the Department.

10. Upon completion of the work described herein, the applicant shall forthwith request, in writing, that a Certificate of Compliance be issued stating that the work has been satisfactorily completed.

ORDER OF CONDITIONS ATTACHMENT

FILE NUMBER _____

1.. Letter from applicant giving froof contractor has submitted the following before notice to proceed:

Itemized Proposal
Bidders Questionaire
Affidavits
Disclosure Statment
Contract Agreement
Performance Bond
Payment Bond

2. All Technical Specification be observed as listed in Table of Contents of the Contract Documents.

3. No opening will be made in the road bed until the gate and stop planks are complete. Protection against erosion and sedimentation going into the river.

4. Necessary precaution be taken to prevent break in dam, coffer dam or other devices used to hold back lake water or runoffs.

5. Adequate water supply and Fire Protection for Brookfield Shoe will be maintained by notifying Brookfield Shoe's Officials and Fire Department when any disruption effects the present water supply line.

6. Size and Strength of Thrust Blocks must be approved by Engineer/Inspector.

7. Any major change in plans or construction will be discussed and approved with the Engineer/Inspector.

8. Contractor will be required to meet all Federal, State and Local construction specification.

9. Contractor will be required to meet conservation requirements.

11. The work shall conform to the following described plans and additional conditions.

The plans are enclosed with the contract documents.

See attachment for additional conditions.

The applicant, any person aggrieved by this order, any owner of land abutting the land upon which the proposed work is to be done, or any ten residents of the city or town in which land is located, are hereby notified of their right to appeal this order to the Department of Environmental Quality Engineering provided the request is made in writing and by certified mail to the Department within ten (10) days from the issuance of this order.

ISSUED BY Ronald E Cole

A public hearing was held Monday, January 25, 1982, 7:30 PM., Municipal Building and there were no objections.

On this 1st day of Feb 19 82, before me personally appeared Ronald Cole, Chairman, Conservation Commission to me known to be the person described in, and who executed, the foregoing instrument and acknowledged that he executed the same as his free act and deed.

Notary Public Barry G. Peterzell My Commission expires 12/2/82

DETACH ON DOTTED LINE AND SUBMIT TO THE ISSUER OF THIS ORDER PRIOR TO COMMENCEMENT OF WORK

TO _____ (Issuing Authority)

PLEASE BE ADVISED THAT THE ORDER OF CONDITIONS FOR THE PROJECT AT Lake Lashaway, Route 9

FILE NUMBER _____, HAS BEEN RECORDED AT THE REGISTRY OF _____

ON (DATE)_____

If recorded land, the instrument number which identifies this transaction is _____

If registered land, the document number which identifies this transaction is _____

Signed _____

Applicant

16.17

FORM 4
ORDER OF CONDITIONS
WETLANDS PROTECTION ACT
G.L. CH. 131 § 40

CITY/TOWN North Brookfield, Ma., 01535
TO: NAME Board of Selectmen
CERTIFIED MAIL NUMBER
PROJECT LOCATION:
Address Bridge on Harrington Street

H Fergerson
J Vaillancourt
K Cross

FILE NUMBER
ADDRESS Conservation Commissi
Main Street
North Brookfield, Ma.,
01535

Recorded at Registry of _____ Book _____ Page _____
Certificate (if registered) _____

REGARDING:
Notice of Intent dated January 26, 1982
and plans titled and dated Plans pending for a retaining wall at the bridge
THIS ORDER IS ISSUED ON (date) February 12, 1982

Pursuant to the authority of G.L. c. 131, § 40 the Conservation Commission has reviewed your Notice of Intent and plans identified above, and has determined that the area on which the proposed work is to be done is significant to one or more of the interests listed in G.L. c. 131, §. 40. The Conservation Commission hereby orders that the following conditions are necessary to protect said interests and all work shall be performed in strict accordance with them and with the Notice of Intent and plans identified above except where such plans are modified by said conditions.

CONDITIONS

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this order.

2. This order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.

3. This order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state or local statues, ordinances, bylaws and/or regulations.

4. The work authorized hereunder shall be completed within one (1) year from the date of this order unless it is for a maintenance dredging project subject to Section 5(9). This order may be extended by the issuing authority for one or more additional one-year periods upon application to the said issuing authority at least thirty (30) days prior to the expiration date of the order or its extension.

5. Any fill used in connection with this project shall be clean fill, containing no trash, refuse, rubbish or debris, including, without limiting the generality of the foregoing, lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles or parts of any of the foregoing.

6. No work may be commenced until all appeal periods have elapsed from the order of the Conservation Commission or from a final order by the Department of Environmental Quality Engineering.

7. No work shall be undertaken until the final order, with respect to the proposed project, has been recorded in the Registry of Deeds for the district in which the land is located within the chain of title of the affected property. The Document number indicating such recording shall be submitted on the form at the end of this order to the issuer of this order prior to commencement of work.

8. A sign shall be displayed at the site not less than two square feet or more than three square feet bearing the words, "Massachusetts Department of Environmental Quality Engineering Number 244-5".

9. Where the Department of Environmental Quality Engineering is requested to make a determination and to issue a superseding order, the Conservation Commission shall be a party to all agency proceedings and hearings before the Department.

10. Upon completion of the work described herein, the applicant shall forthwith request, in writing, that a Certificate of Compliance be issued stating that the work has been satisfactorily completed.

11. The work shall conform to the following described plans and additional conditions.

Specification for plans are pending

See attachment for addition conditions

The applicant, any person aggrieved by this order, any owner of land abutting the land upon which the proposed work is to be done, or any ten residents of the city or town in which land is located, are hereby notified of their right to appeal this order to the Department of Environmental Quality Engineering provided the request is made in writing and by certified mail to the Department within ten (10) days from the issuance of this order.

ISSUED BY Lawrence F. Underwood

A public hearing was held Tuesday, February 9, 1982, 7:30 PM, Town House, North Brookfield and there were no objectic

On this 9th day of Feb, 1982 before me personally appeared Lawrence F. Underwood Ch. N.B.C. Comm., to me known to be the person described in, and who executed, the foregoing instrument and acknowledged that he executed the same as his free act and deed.

Notary Public Beverly A. Lundi My Commission expires March 3 1983

DETACH ON DOTTED LINE AND SUBMIT TO THE ISSUER OF THIS ORDER PRIOR TO COMMENCEMENT OF WORK

TO _____ (Issuing Authority)

PLEASE BE ADVISED THAT THE ORDER OF CONDITIONS FOR THE PROJECT AT Bridge on Harrington Street

FILE NUMBER _____, HAS BEEN RECORDED AT THE REGISTRY OF _____

ON (DATE) _____.

If recorded land, the instrument number which identifies this transaction is _____

If registered land, the document number which identifies this transaction is _____

Signed _____

Applicant

Order of Conditions Attachment

File Number ----------

1. Engineering Plans/Specification be submitted to DEQE (Worcester)

2. Letter from East Brookfield Conservation Commission given proof that order of East Brookfield order of conditions have been fullfilled.

3. Letter from applicant given proof that all Technical Specifications be observed as listed in Table of Contents of the Construction Documents when present

4. Contractor will be required to meet conservation requirements.

5. An agreement will be considered to place:

   a. No Swimming and Danger Sign at retaining wall.

   b. Danger Buoys be placed from spring to fall at retaining wall if necessary.

Enclosed.. Copy of East Brookfield Order of Conditions.

ANTHONY D. CORTESE, Sc. D.
Commissioner

The Commonwealth of Massachusetts

Executive Office of Environmental Affairs
Department of Environmental Quality Engineering
Division of Waterways
ONE *Winter Street, Boston* 02108

March 12, 1982

Water Resources Commission
Division of Water Pollution Control
Water Quality and Research Section
P.O. Box 545
Westborough, MA 01584

Re: Lake Lashaway
Outlet Structure

Att: Russell A. Isaac, Ph.D., P.E.

Dear Sir:

In response to your letter regarding the Lake Lashaway control structure, acccording to the description and the plans submitted, we find that a permit under Chapter 253 of the Massachusetts General Laws is not required.

The plans and description of the proposed project will be kept on file with the Division of Waterways. In the event that changes are to be made for this project; before such changes can be effected, a description and plans of such changes must be submitted to the Division of Waterways for review and subsequent approval.

Very truly yours,

John J. Hannon, P.E.
Chief Engineer

JI:em

EDWARD J. KING
GOVERNOR

JOHN A. BEWICK
SECRETARY

The Commonwealth of Massachusetts
Executive Office of Environmental Affairs
100 Cambridge Street
Boston, Massachusetts 02202

CERTIFICATE OF THE SECRETARY ENVIRONMENTAL AFFAIRS

ON

FINAL ENVIRONMENTAL IMPACT REPORT

PROJECT NAME:	Lake Lashaway Drawdown Project & Outlet Construction
PROJECT LOCATION:	E. Brookfield, N. Brookfield
EOEA NUMBER:	4368 4368
PROJECT PROPONENT:	Town of East Brookfield
DATE NOTICED IN MONITOR:	March 22, 1982

The Secretary of Environmental Affairs herein issues a statement that the Final Environmental Impact Report submitted in the above referenced project does adequately and properly comply with Massachusetts General Laws, Chapter 30, Section 62-62H inclusive, and the regulations implementing MEPA.

August 10, 1982
DATE

JOHN A. BEWICK, SECRETARY

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDOD-R-24-82-046
MA-EABR-82-310

4 October 1982

Town of East Brookfield
Town Hall
Depot Square
East Brookfield, MA 01515

Gentlemen:

Attached is your Department of the Army permit authorizing the work described. As explained in our last letter, this is a limited authorization containing a stated set of conditions which must be complied with. Although a contractor may perform the work for you, you are responsible for assuring the work is done in conformance with the conditions and limitations of this permit. Please be sure the person who will do the work has read and understands the conditions of the permit.

Performing any work not specifically authorized by this permit, or failing to comply with its conditions, may subject you to the enforcement provisions of our regulations.

If any change in the plans or construction methods is found necessary, please contact us immediately to discuss modification of your permit. Any change must be approved before it is undertaken.

Condition (n) of this permit requires that you notify us before the work is begun so we may make timely inspections to insure compliance. To assist you in meeting this condition we have attached a notification form for you to fill out and return to us as soon as you are aware of when you intend to begin work.

Good luck with your project.

Sincerely,

WILLIAM F. LAWLESS
Chief, Regulatory Branch
Operations Division

Incl
as stated

Copy furnished:
Charles Abysalh
Ward Street
North Brookfield, MA 01535

Application No 24-82-046 Permit Number MA-EABR-32-310

Name of Applicant East Brookfield, Town of

Effective Date 4 October 1982

Expiration Date (If applicable) _____

DEPARTMENT OF THE ARMY
PERMIT

Referring to written request dated 11 January 1982 for a permit to

( ) Perform work in or affecting navigable waters of the United States, upon the recommendation of the Chief of Engineers, pursuant to Section 10 of the Rivers and Harbors Act of March 3, 1899 (33 U.S.C. 403).

(X) Discharge dredged or fill material into waters of the United States upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 404 of the Federal Water Pollution Control Act (86 Stat. 816, P.L. 92-500).

( ) Transport dredged material for the purpose of dumping it into ocean waters upon the issuance of a permit from the Secretary of the Army acting through the Chief of Engineers pursuant to Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (86 Stat. 1052, P.L. 92-532);

Town of East Brookfield
Town Hall
Depot Square
East Brookfield, Massachusetts 01515

is hereby authorized by the Secretary of the Army:

to construct and maintain an outlet structure. Approximately 30 cubic yards of concrete is to be placed below the ordinary high water line for construction of the outlet.

Construct a temporary sandbag cofferdam across the Five Mile River under the Harrington Street Bridge to maintain the existing water table upstream and minimize impacts to adjacent wetlands during the drawdown. Approximately 5 cubic yards of sand will be used. (continued on page 3)

in Lake Lashaway

at East Brookfield, North Brookfield, Massachusetts

in accordance with the plans and drawings attached hereto which are incorporated in and made a part of this permit (on drawings: give file number or other definite identification marks.) "Lake Lashaway Outlet Structure" dated "April 1980" in 2 sheets.

subject to the following conditions:

1. General Conditions:

a. That all activities identified and authorized herein shall be consistent with the terms and conditions of this permit; and that any activities not specifically identified and authorized herein shall constitute a violation of the terms and conditions of this permit which may result in the modification, suspension or revocation of this permit, in whole or in part, as set forth more specifically in General Conditions j or k hereto, and in the institution of such legal proceedings as the United States Government may consider appropriate, whether or not this permit has been previously modified, suspended or revoked in whole or in part.

ENG FORM 1 JUL 77 1721 EDITION OF 1 APR 74 IS OBSOLETE. (ER 1145-2 303)

o That if the activity authorized herein is not started on or before _____ day of N/A, 19 _____, (one year from the date of issuance of this permit unless otherwise specified) and is not completed on or before 31st day of December, 19 85, (three years from the date of issuance of this permit unless otherwise specified) this permit if not previously revoked or specifically extended, shall automatically expire

p. That this permit does not authorize or approve the construction of particular structures, the authorization or approval of which may require authorization by the Congress or other agencies of the Federal Government.

q. That if and when the permittee desires to abandon the activity authorized herein, unless such abandonment is part of a transfer procedure by which the permittee is transferring his interests herein to a third party pursuant to General Condition t hereof, he must restore the area to a condition satisfactory to the District Engineer.

r That if the recording of this permit is possible under applicable State or local law, the permittee shall take such action as may be necessary to record this permit with the Register of Deeds or other appropriate official charged with the responsibility for maintaining records of title to and interests in real property.

s That there shall be no unreasonable interference with navigation by the existence or use of the activity authorized herein.

t That this permit may not be transferred to a third party without prior written notice to the District Engineer, either by the transferee's written agreement to comply with all terms and conditions of this permit or by the transferee subscribing to this permit in the space provided below and thereby agreeing to comply with all terms and conditions of this permit. In addition, if the permittee transfers the interests authorized herein by conveyance of realty, the deed shall reference this permit and the terms and conditions specified herein and this permit shall be recorded along with the deed with the Register of Deeds or other appropriate official.

II. Special Conditions (Here list conditions relating specifically to the proposed structure or work authorized by this permit)

a. Adequate sedimentation and erosion control devices, such as hay bales or other devices capable of filtering the fines involved, shall be implemented and properly maintained to minimize impacts during construction. These devices must be removed when no longer needed.

b. No temporary fill (i.e. access roads and/or cofferdams) may be placed in waters or wetlands unless specifically authorized by this permit. When temporary fill is authorized, it shall be disposed of at an upland site and suitably contained to prevent run-off from re-entering a waterway or wetland, and the area restored to its approximate original contours.

c. Drawdown shall begin no sooner than October 1 with a stable low level reached by December 15. Reflooding shall be completed by March 1.

(continued from page 1)

The outlet structure will allow annual drawdown of the lake, during winter periods, to freeze kill excessive aquatic vegetation which is present in the lake.

b. That all activities authorized herein shall, if they involve, during their construction or operation, any discharge of pollutants into waters of the United States or ocean waters, be at all times consistent with applicable water quality standards, effluent limitations and standards of performance, prohibitions, pretreatment standards and management practices established pursuant to the Federal Water Pollution Control Act of 1972 (P.L. 92-500, 86 Stat. 816), the Marine Protection, Research and Sanctuaries Act of 1972 (P.L. 92-532, 86 Stat. 1052), or pursuant to applicable State and local law.

c. That when the activity authorized herein involves a discharge during its construction or operation, of any pollutant (including dredged or fill material), into waters of the United States, the authorized activity shall, if applicable water quality standards are revised or modified during the term of this permit, be modified, if necessary, to conform with such revised or modified water quality standards within 6 months of the effective date of any revision or modification of water quality standards, or as directed by an implementation plan contained in such revised or modified standards, or within such longer period of time as the District Engineer, in consultation with the Regional Administrator of the Environmental Protection Agency, may determine to be reasonable under the circumstances.

d. That the discharge will not destroy a threatened or endangered species as identified under the Endangered Species Act, or endanger the critical habitat of such species.

e. That the permittee agrees to make every reasonable effort to prosecute the construction or operation of the work authorized herein in a manner so as to minimize any adverse impact on fish, wildlife, and natural environmental values.

f. That the permittee agrees that he will prosecute the construction or work authorized herein in a manner so as to minimize any degradation of water quality.

g. That the permittee shall permit the District Engineer or his authorized representative(s) or designee(s) to make periodic inspections at any time deemed necessary in order to assure that the activity being performed under authority of this permit is in accordance with the terms and conditions prescribed herein.

h. That the permittee shall maintain the structure or work authorized herein in good condition and in accordance with the plans and drawings attached hereto.

i. That this permit does not convey any property rights, either in real estate or material, or any exclusive privileges; and that it does not authorize any injury to property or invasion of rights or any infringement of Federal, State, or local laws or regulations nor does it obviate the requirement to obtain State or local assent required by law for the activity authorized herein.

j. That this permit may be summarily suspended, in whole or in part, upon a finding by the District Engineer that immediate suspension of the activity authorized herein would be in the general public interest. Such suspension shall be effective upon receipt by the permittee of a written notice thereof which shall indicate (1) the extent of the suspension, (2) the reasons for this action, and (3) any corrective or preventative measures to be taken by the permittee which are deemed necessary by the District Engineer to abate imminent hazards to the general public interest. The permittee shall take immediate action to comply with the provisions of this notice. Within ten days following receipt of this notice of suspension, the permittee may request a hearing in order to present information relevant to a decision as to whether his permit should be reinstated, modified or revoked. If a hearing is requested, it shall be conducted pursuant to procedures prescribed by the Chief of Engineers. After completion of the hearing, or within a reasonable time after issuance of the suspension notice to the permittee if no hearing is requested, the permit will either be reinstated, modified or revoked.

k. That this permit may be either modified, suspended or revoked in whole or in part if the Secretary of the Army or his authorized representative determines that there has been a violation of any of the terms or conditions of this permit or that such action would otherwise be in the public interest. Any such modification, suspension, or revocation shall become effective 30 days after receipt by the permittee of written notice of such action which shall specify the facts or conduct warranting same unless (1) within the 30-day period the permittee is able to satisfactorily demonstrate that (a) the alleged violation of the terms and the conditions of this permit did not, in fact, occur or (b) the alleged violation was accidental, and the permittee has been operating in compliance with the terms and conditions of the permit and is able to provide satisfactory assurances that future operations shall be in full compliance with the terms and conditions of this permit; or (2) within the aforesaid 30-day period, the permittee requests that a public hearing be held to present oral and written evidence concerning the proposed modification, suspension or revocation. The conduct of this hearing and the procedures for making a final decision either to modify, suspend or revoke this permit in whole or in part shall be pursuant to procedures prescribed by the Chief of Engineers.

l. That in issuing this permit, the Government has relied on the information and data which the permittee has provided in connection with his permit application. If, subsequent to the issuance of this permit, such information and data prove to be false, incomplete or inaccurate, this permit may be modified, suspended or revoked, in whole or in part, and/or the Government may, in addition, institute appropriate legal proceedings.

m. That any modification, suspension, or revocation of this permit shall not be the basis for any claim for damages against the United States.

n. That the permittee shall notify the District Engineer at what time the activity authorized herein will be commenced, as far in advance of the time of commencement as the District Engineer may specify, and of any suspension of work, if for a period of more than one week, resumption of work and its completion.

The following Special Conditions will be applicable when appropriate

STRUCTURES IN OR AFFECTING NAVIGABLE WATERS OF THE UNITED STATES.

a That this permit does not authorize the interference with any existing or proposed Federal project and that the permittee shall not be entitled to compensation for damage or injury to the structures or work authorized herein which may be caused by or result from existing or future operations undertaken by the United States in the public interest.

b That no attempt shall be made by the permittee to prevent the full and free use by the public of all navigable waters at or adjacent to the activity authorized by this permit.

c That if the display of lights and signals on any structure or work authorized herein is not otherwise provided for by law, such lights and signals as may be prescribed by the United States Coast Guard shall be installed and maintained by and at the expense of the permittee

d That the permittee, upon receipt of a notice of revocation of this permit or upon its expiration before completion of the authorized structure or work, shall, without expense to the United States and in such time and manner as the Secretary of the Army or his authorized representative may direct, restore the waterway to its former conditions. If the permittee fails to comply with the direction of the Secretary of the Army or his authorized representative, the Secretary or his designee may restore the waterway to its former condition, by contract or otherwise, and recover the cost thereof from the permittee.

e Structures for Small Boats That permittee hereby recognizes the possibility that the structure permitted herein may be subject to damage by wave wash from passing vessels. The issuance of this permit does not relieve the permittee from taking all proper steps to insure the integrity of the structure permitted herein and the safety of boats moored thereto from damage by wave wash and the permittee shall not hold the United States liable for any such damage.

MAINTENANCE DREDGING.

a. That when the work authorized herein includes periodic maintenance dredging, it may be performed under this permit for _____years from the date of issuance of this permit (ten years unless otherwise indicated);

b. That the permittee will advise the District Engineer in writing at least two weeks before he intends to undertake any maintenance dredging.

DISCHARGES OF DREDGED OR FILL MATERIAL INTO WATERS OF THE UNITED STATES

a. That the discharge will be carried out in conformity with the goals and objectives of the EPA Guidelines established pursuant to Section 404(b) of the FWPCA and published in 40 CFR 230;

b. That the discharge will consist of suitable material free from toxic pollutants in other than trace quantities;

c. That the fill created by the discharge will be properly maintained to prevent erosion and other non-point sources of pollution; and

d. That the discharge will not occur in a component of the National Wild and Scenic River System or in a component of a State wild and scenic river system.

DUMPING OF DREDGED MATERIAL INTO OCEAN WATERS:

a. That the dumping will be carried out in conformity with the goals, objectives, and requirements of the EPA criteria established pursuant to Section 102 of the Marine Protection, Research and Sanctuaries Act of 1972, published in 40 CFR 220-228.

b. That the permittee shall place a copy of this permit in a conspicuous place in the vessel to be used for the transportation and/or dumping of the dredged material as authorized herein.

This permit shall become effective on the date of the District Engineer's signature.

Permittee hereby accepts and agrees to comply with the terms and conditions of this permit.

Town of East Brookfield

By Robert J. Duncan Selectman

Robert J. PERMITTEE

October 1, 1982

DATE

BY AUTHORITY OF THE SECRETARY OF THE ARMY

for CARL B. SCIPLE
Colonel, Corps of Engineers
Division Engineer

[illegible]

DATE

Transferee hereby agrees to comply with the terms and conditions of this permit.

TRANSFEREE

DATE

mike

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDOD-R-24-82-046

TO: Corps of Engineers
Regulatory Branch
Surveillance & Enforcement Section

I have received authorization to construct and maintain an outlet structure. Approximately 30 cubic yards of concrete is to be placed below the ordinary high water line for construction of the outlet.

Under permit No. MA-EABR-82-310 . The work will be performed by:

Name of Person or Firm Marois Brothers Inc.

Address 965 Millbury St.
Worcester, MA 01607

Telephone No. 791-8134

who is aware of the conditions and limitations of this authorization.

The work will begin on approximately October 4,1982 and should be completed by February 1, 1983.

Robert J. Bain
Permittee

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO ATTENTION OF

September 23, 1983

Operations Division, Regulatory Branch
NEDOD-R-23-83-530

Town of East Brookfield
Town Hall
Depot Square
East Brookfield, Massachusetts 01515

Dear Sirs:

This is in response to your recent request to amend your permit number MA-EABR-82-310. The permit authorizes, in part, the construction of a temporary sandbag cofferdam across the Five Mile River at the Harrington Street Bridge to maintain the existing water table upstream and minimize the impacts to the adjacent wetlands during the annual drawdown.

The permit has a special condition that states that the drawdown shall not begin before October 1 with a stable low level reached by December 15 and that reflooding shall be completed by March 1. You requested amending this condition to allow drawdown to begin September 20. In addition, you requested that the permit be amended to allow the construction of a temporary concrete barrier structure with stop logs south of the bridge, in lieu of the cofferdam. This proposed work is shown on your attached plan entitled "Proposed Temporary Barrier in Five Mile River" in one sheet dated "7/7/83".

Your permit is hereby amended to allow the drawdown to begin September 20 and to allow the proposed construction changes in accordance with the attached plans. All other conditions of your permit remain in full force and effect.

Prior to construction, you are required to obtain any necessary state and/or local permits.

Should you have any questions, you may contact Ms. Kathleen Goodrich at (617) 647-8495 or use our toll-free number 1-800-362-4367.

BY AUTHORITY OF THE SECRETARY OF THE ARMY:

Carl B. Sciple
Colonel, Corps of Engineers
Division Engineer

Attached

Copies Furnished:
Charles Abysalh, Administrator, Ward Street, North Brookfield, MA 01535
Michael Ackerman, MA Executive Office of Environmental Affairs, Dept. of Environmental Quality Engineering, Division of Water Pollution Control, Westview Building, Lyman School, Westborough, MA 01581
Lee McLaughlin, Mass. Division of Fisheries & Wildlife, Temple Street West Boylston, MA 01583

APPENDIX VI

Contract Change Orders for Outlet Control Structure

TO: (CONTRACTOR)

Marois Brothers, Inc.

965 Millbury Street

Worcester, MA 01607

CHANGE ORDER NO. 1

DATE: September 21, 1982

PROJECT: Construction of a Culvert and Outlet Works at Lake Lashaway

You are hereby directed to make the following change in this Contract:

1. Excavate unsuitable material under proposed outlet structure.
2. Backfill excavated area with gravel borrow.
3. Drive four (4) piles for foundation of outlet structure.
4. Increase outlet structure footing from 12 inches thick to 18 inches thick to function as a pile cap.

The original Contract Sum was	$ 252,875.00
Net change by prevous Change Orders	$ 0.00
The Contract Amount to this Change Order was	$ 252,875.00
The Contract Amount will be (increased) ~~(decreased)~~ by this Change Order	$ 8,750.00
The new Contract Amount including this Change Order will be	$ 261,625.00
Time for Completion.will be (increased) ~~(decreased)~~ ~~(unchanged)~~ by	5 working days
The Date of Completion as of the date of this Change Order therefore is	December 10, 19

Recommended by William C. Bomtard, Engineer — 9-21-82, Date

Accepted by Howard R. Marois, Contractor — 9-21-82, Date

Approved by Charles G. Abyad, Owner — 9-21-82, Date

This document shall become an amendment to the Contract and all provisions of the Contract will apply hereto.

CONTRACT CHANGE ORDER

TO: (CONTRACTOR)

Marois Brothers, Inc.

965 Millbury Street

Worcester, Massachusetts 01607

CHANGE ORDER NO. 2

DATE: October 6, 1982

PROJECT: Construction of a Culvert and Outlet Works at Lake Lashaway

You are hereby directed to make the following change in this Contract:

Supply and install a temporary by-pass for the Brookfield Shoe fire pump intake.

The original Contract Sum was	$ 252,875.00
Net change by prevous Change Orders	$ 8,750.00
The Contract Amount to this Change Order was	$ 261,625.00
The Contract Amount will be (increased) (~~decreased~~) by this Change Order	$ 5,837.00
The new Contract Amount including this Change Order will be	$ 267,462.00
Time for Completion will be (~~increased~~) (~~decreased~~) (unchanged) by	0 days
The Date of Completion as of the date of this Change Order therefore is	December 10, 19

Recommended by William C. Bombard, Engineer — Date 10/12/82

Accepted by Howard R. Marois, Contractor — Date 10/8/82

Approved by Charles H. Aldrich, Owner — Date 10/12/82

This document shall become an amendment to the Contract and all provisions of the Contract will apply hereto.

TO: (CONTRACTOR)

Marois Brothers, Inc.

965 Millbury Street

Worcester, Massachusetts 01607

CHANGE ORDER NO. 3

DATE: October 6, 1982

PROJECT: Construction of a Culvert and Outlet Works at Lake Lashaway

You are hereby directed to make the following change in this Contract:

Cost of temporarily relocating Massachusetts Electric lines to accomodate the installation of the sheeting required.

The original Contract Sum was.....$	252,875.00
Net change by prevous Change Orders.....$	14,587.00
The Contract Amount to this Change Order was.....$	267,462.00
The Contract Amount will be (increased) ~~(decreased)~~ by this Change Order.....$	4,575.00
The new Contract Amount including this Change Order will be.....$	272,037.00
Time for Completion will be ~~(increased)~~/~~(decreased)~~ (unchanged) by.....	0 days
The Date of Completion as of the date of this Change Order therefore is.....	December 10, 19

Recommended by William C. Bomstead, Engineer — 10/12/82, Date

Accepted by Norman R. Marois, Contractor Pres. — 10/8/82, Date

Approved by Charles G. Aloyalh, Owner — 10/12/82, Date

This document shall become an amendment to the Contract and all provisions of the Contract will apply hereto.

TO: (CONTRACTOR)

Marois Brothers, Inc.

965 Millbury Street

Worcester, Massachusetts 01607

CHANGE ORDER NO. 4

DATE: October 6, 1982

PROJECT: Construction of a Culvert and Outlet Works at Lake Lashaway

You are hereby directed to make the following change in this Contract:

Increase the wall thickness of the outlet structure around the 48" pipe from 12" to 24".

The original Contract Sum was.....$	252,875.00
Net change by prevous Change Orders.....$	19,162.00
The Contract Amount to this Change Order was.....$	272,037.00
The Contract Amount will be (increased) ~~(decreased)~~ by this Change Order.....$	500.00
The new Contract Amount including this Change Order will be.....$	272,537.00
Time for Completion will be ~~(increased)~~ ~~(decreased)~~ (unchanged) by.....	0 days
The Date of Completion as of the date of this Change Order therefore is.....	December 10, 19

Recommended by William C. Bombard, Engineer — Date 10/12/82

Accepted by Normand R. Marois, Contractor Pres. — Date 10/8/82

Approved by Charles G. Adyeath, Owner — Date 10/12/82

This document shall become an amendment to the Contract and all provisions of the Contract will apply hereto.

CONTRACT CHANGE ORDER

TO: (CONTRACTOR)

Marois Brothers, Inc.

965 Millbury Street

Worcester, Massachusetts

CHANGE ORDER NO. 5

DATE: November 1, 1982

PROJECT: Construction of a Culvert and Outlet Works at Lake Lashaway

You are hereby directed to make the following change in this Contract:

Fabricate and install a security gate, to be attached to the concrete headwall of the 48 inch culvert, in accordance with the attached sketch.

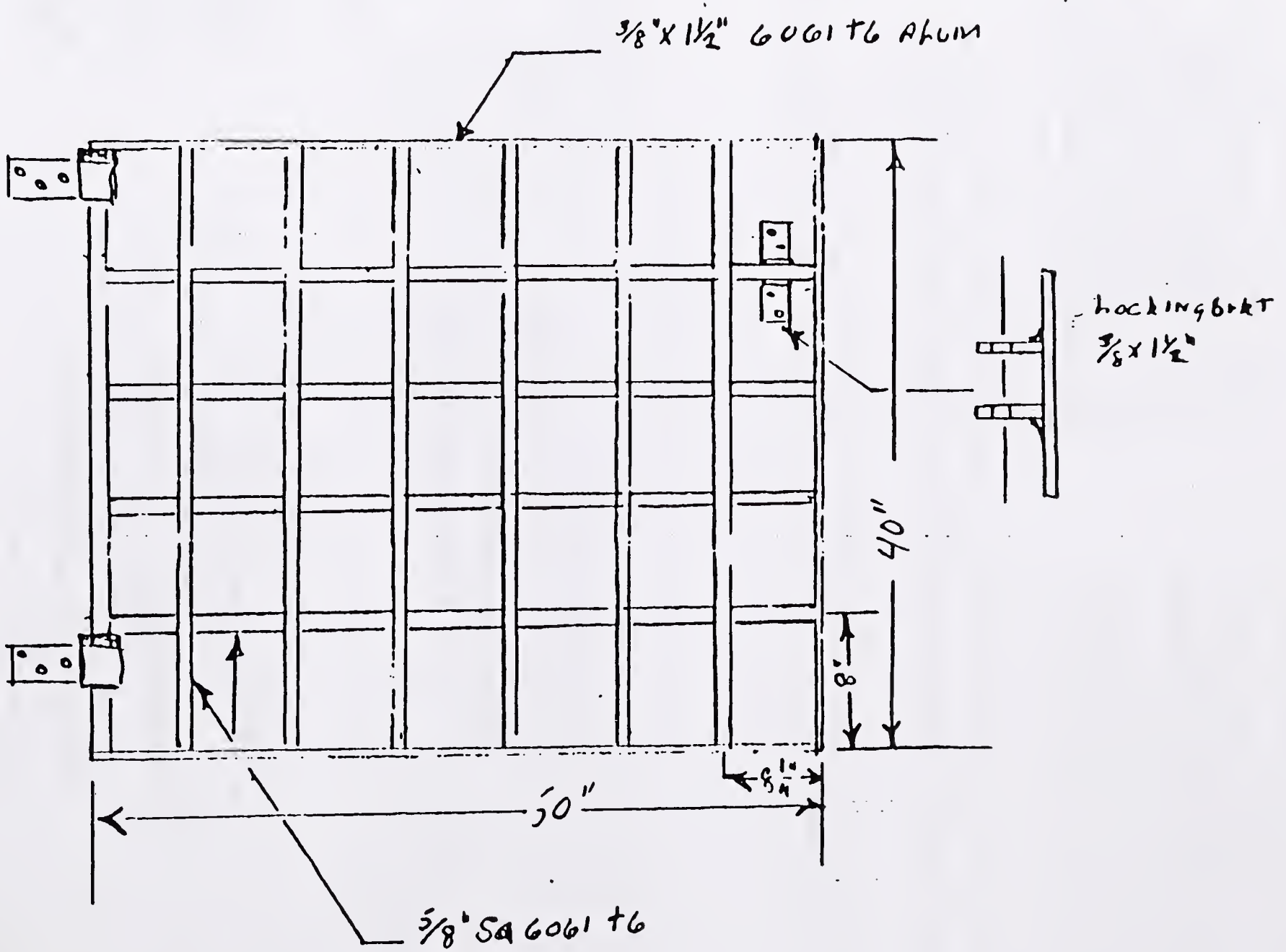
The original Contract Sum was	$ 252,875.00
Net change by previous Change Orders	$ 19,662.00
The Contract Amount to this Change Order was	$ 272,537.00
The Contract Amount will be (increased) ~~(decreased)~~ by this Change Order	$ 450.00
The new Contract Amount including this Change Order will be	$ 272,987.00
Time for Completion will be ~~(increased)~~ (unchanged) by	0 days
The Date of Completion as of the date of this Change Order therefore is	December 10, 1

Recommended by William C. Bombard
Engineer — Date 11/09/82

Accepted by Normand R. Marois
Contractor — Date 11/19/82

Approved by Charles G. Reynolds
Owner — Date 11/19/82

This document shall become an amendment to the Contract and all provisions the Contract will apply hereto.



TO: (CONTRACTOR)

Marois Brothers, Inc.

965 Millbury Street

Worcester, Massachusetts

CHANGE ORDER NO. 6

DATE: November 19, 1982

PROJECT: Construction of a Culvert and Outlet Works at Lake Lashaway

You are hereby directed to make the following change in this Contract:

Furnish and install four-foot galvanized chain-link fence on the concrete headwall of the 48-inch culvert with 2-inch end-posts and top and bottom rails.

The original Contract Sum was	$ 252,875.00
Net change by prevous Change Orders	$ 20,112.00
The Contract Amount to this Change Order was	$ 272,987.00
The Contract Amount will be (increased) (~~decreased~~) by this Change Order	$ 460.00
The new Contract Amount including this Change Order will be	$ 273,447.00
Time for Completion will be ~~increased/decreased~~ (unchanged) by	0 days
The Date of Completion as of the date of this Change Order therefore is	December 10, 1

Recommended by William A Bonstead, Engineer — 11/19/82 Date

Accepted by Norman R. Marois, Contractor — 11/19/82 Date

Approved by Charles G Akyalek — 11/19/82 Date

This document shall become an amendment to the Contract and all provisions of the Contract will apply hereto.

10:2 05

CONTRACT CHANGE ORDER

TO: (CONTRACTOR)

Marois Brothers, Inc.

965 Millbury Street

Worcester, Massachusetts 01604

CHANGE ORDER NO. 7

DATE: March 31, 1983

PROJECT: Construction of a Culvert and Outlet Works at Lake Lashaway

You are hereby directed to make the following change in this Contract:

Modifications to vacuum priming system per your letter of 3/11/83.

(see attached cost breakdown)

The original Contract Sum was	$ 252,875.00
Net change by prevous Change Orders	$ 20,572.00
The Contract Amount to this Change Order was	$ 273,447.00
The Contract Amount will be (increased) (~~decreased~~) by this Change Order	$ 792.35
The new Contract Amount including this Change Order will be	$ 274,239.35
Time for Completion will be (~~increased~~)(~~decreased~~) (unchanged) by	0 days
The Date of Completion as of the date of this Change Order therefore is	December 10,

Recommended by William C. Bartlett, Jr. Engineer — Date 4/14/83

Accepted by Normand R. Marois Bros. Contractor — Date 4/20/83

Approved by _____ Owner — Date _____

This document shall become an amendment to the Contract and all provisions of the Contract will apply hereto.

10 : 2 06

CHANGE ORDER #7

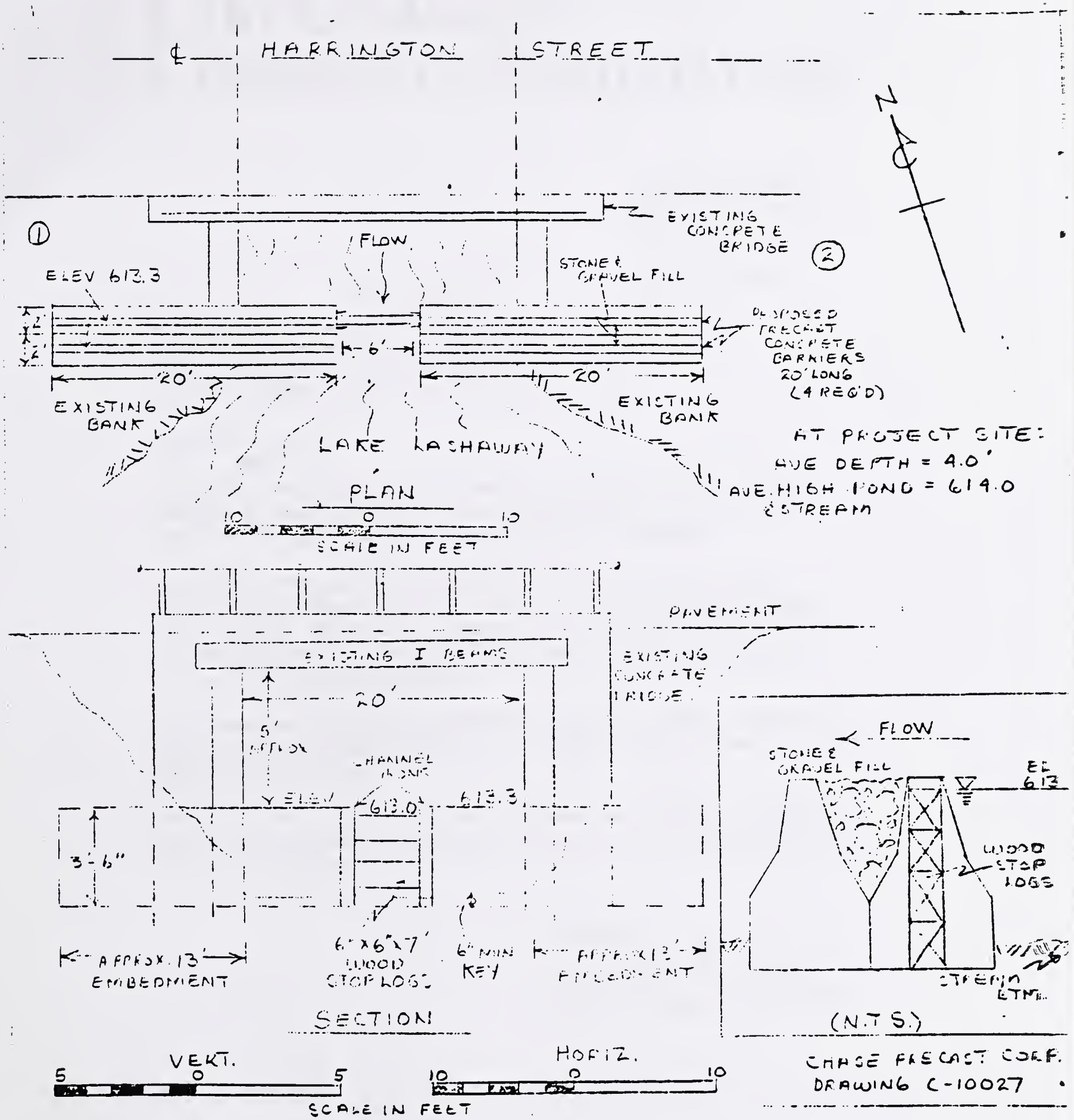
LAKE LASHAWAY RESTORATION PROJECT

EAST BROOKFIELD, MA.

Materials:		
Add	2-2" WYE Strainers	
	2-2" Gate Valves	
	2-1/2" Gate Valves	
	4-2" Nipples	
	2-2" Unions	
	2-1/2" Unions	
	2-1/2" Nipple	
	Miscellaneous Material	$243.48
Labor:		
Add.	4 Hours Mechanic and Truck	160.32
	Modification to Alarm System	214.56
	Sub Total	$626.36
	Overhead & Profit +10%	62.64
	Total	$689.00
General Contractor's Mark-up (+15%)		103.35
	TOTAL	$792.35

APPENDIX VII

Check Dam Construction Drawing



PURPOSE: RETENTION OF WATER IN UPPER WETLAND DURING LAKE DRAWDOWN

DATUM: N.G.U.D OF 1929

ADJACENT PROPERTY OWNERS:

① MR & MRS. JAMES WESTWELL

② MASS. ELECTRIC

~ PROPOSED TEMPORARY BARRIER ~

IN FIVE MILE RIVER

WORCESTER COUNTY MASS.

APPLICATION BY TOWN OF E. BROOKFIELD

SHEET OF DATE: 7/7/83

APPENDIX VIII

Phase II Project Evaluation Testimonies

Lake Lashaway Community Association

49 Shore Road
North Brookfield
Ma., 01535

July 16, 1990

Mr. Robert C Haynes Ph. D.
Div. of Water Pollution Control
Lyman School Grds., Westview Bldg.
Westboro, Ma., 01581

Dear Mr. Haynes:

Please be advised that the members of the Lake Lashaway Community Association is most appreciative for the State and Federal grant under the Clean Lakes Program.

The grant provided construction of a 48" culvert under Rte. 9, East Brookfield, a yearly draw-down of Lake Lashaway through the winter months and an extra bonus by making it possible to dry dredge 18,000 cubic yards of sedimentation from the inlet area.

All these activities have helped greatly to meet our long range lake management program in controlling nuisance aquatic plant growth.

We extend our sincere thanks to State and Federal personnel for their efforts in making the Clean Lakes Grant possible to meet our needs.

Sincerely,

Robert E Munyon

Robert E Munyon, President

Town of East Brookfield, Massachusetts

BOARD OF SELECTMEN

Municipal Building
Post Office Box 147
East Brookfield, Massachusetts 01515

June 25, 1990

Mr. Robert C. Haynes, Ph.D.
Division of Water Pollution Control
Lyman School, Westview Building
Westborough, MA 01581

Dear Mr. Haynes,

This letter is to advise you of our feelings on the effectiveness of the outlet structure and drawdown procedures instituted on Lake Lashaway as a result of grants from both the state and federal governments.

The results have been very positive and there has been a noticeable improvement in the water quality, weed control, and also in the recreational use of the lake. The size and quality of fish now being caught has improved since the reduction in the amount of weed growth.

The mechanics of lowering and raising the water level are quite simple and maintenance has been minimal.

Please extend our gratitude to your division for all of their help in this project.

Sincerely yours,

Town of East Brookfield
Board of Selectmen

Robert J. Bain, Chairman

RJB/mp

23 JAN 90 12: 21

TOWN OF NORTH BROOKFIELD

MASSACHUSETTS 01535

OFFICE OF THE BOARD OF SELECTMEN
867-2907

Richard P. Chabot
CHAIRMAN
Joseph A. Valencourt, Jr.
VICE CHAIRMAN
Frank Hubacz, Jr.
CLERK

August 3, 1990

Mr. Robert C. Haynes, Ph. D.
Division of Water Pollution Control
Lyman School Grds., Westview Bldg.
Westboro, MA 01581

Dear Mr. Haynes:

Grants from both the State and Federal Government were used to install a culvert with an adjustable gate in Lake Lashaway so that the lake can be drawn down in the Winter time. This procedure is to Winter kill weeds that grew around the shore of the lake and were choking many areas, particularly the cove areas.

The results have been excellent, with vast improvements in weed control, water quality, and the size and quality of the fish. There has also been a great improvement in the recreational use of the lake.

We are very greatful for all the help from your division in saving our beautiful lake.

Very truly yours,

Richard P. Chabot, Chairman

Joseph A. Valencourt, Jr.

Frank Hubacz, Jr.
Board of Selectmen

APPENDIX IX

MONITORING PROGRAM DATABASE

Database Units of Measure:

Depth = meters

Temp. = °C

pH = units

Spec. Cond. = μmhos/cm

Secchi = meters

Coliforms = coliforms/100 ml

All other parameters reported as mg/L

LAKE LASHAWAY MONITORING PROGRAM DATABASE (See prior page for units of measure).

DATE	STATION	SAMPLE DEPTH	TEMP	DO	PH	SPEC. COND.	TOTAL ALK.	TOTAL HARD.	TKN	NITRATE	AMMONIA	TOTAL PHOSPHATE	CHLORIDE	SUSPENDED SOLIDS	TOTAL SOLIDS	SECCHI DISC	TOTAL COLIFORM	FECAL COLIFORM
04-Aug-82	01	0.0	24.8	8.5	6.4	54	9.0	14.0	0.58	N.D.	0.01	0.05	4.0	4.0	56	1.4	--	--
07-Sep-82	01	0.0	20.4	8.5	5.4	59	11.0	19.0	0.51	N.D.	0.05	0.14	5.0	2.0	50	--	20	<10
06-Oct-82	01	0.0	17.7	8.5	6.8	48	10.0	17.0	0.62	0.10	0.08	0.02	5.0	2.0	24	--	<10	<5
22-Nov-82	01	0.0	8.2	10.4	6.9	55	12.0	19.0	0.42	0.20	0.11	0.04	6.0	1.0	30	3.2	110	15
23-May-83	01	0.0	17.9	11.3	5.4	56	9.0	13.0	0.75	0.20	0.09	0.06	4.0	0.8	66	1.8	<10	<5
08-Jun-83	01	0.0	19.4	10.2	5.3	51	9.0	13.0	0.65	N.D.	0.05	0.04	1.0	2.5	20	1.6	60	<5
06-Jul-83	01	0.0	25.4	7.8	6.2	65	8.0	14.0	0.69	N.D.	N.D.	0.04	2.0	0.5	22	1.8	10	5
04-Aug-83	01	0.0	26.1	8.1	5.5	51	12.0	14.0	0.49	0.50	0.13	0.07	4.0	3.0	54	--	3600	340
19-Sep-83	01	0.0	21.0	9.0	5.9	48	12.0	15.0	1.00	N.D.	0.20	0.06	5.0	2.0	22	2.4	40	<5
10-Apr-84	01	0.0	6.6	11.6	5.9	45	7.0	12.0	0.18	0.30	0.05	0.09	6.0	0.5	38	2.2	--	--
02-May-84	01	0.0	12.8	10.7	5.8	49	6.0	12.0	1.10	0.30	0.01	0.03	4.0	2.0	8	2.3	--	--
17-Jul-84	01	0.0	25.2	8.8	6.7	50	7.0	13.0	0.36	N.D.	0.16	0.05	3.0	1.5	24	1.4	20	<5
06-Sep-84	01	0.0	20.3	7.4	5.3	54	24.0	8.0	1.80	0.40	0.37	0.06	4.0	8.5	40	1.8	--	--
25-Mar-85	01	0.0	--	--	--	--	7.0	15.0	0.50	0.30	0.03	0.04	6.0	7.0	57	--	<10	<10
30-Apr-85	01	0.0	14.3	9.8	6.0	62	4.0	15.0	0.59	0.20	0.03	0.09	6.0	6.0	68	2.8	<20	<10
30-May-85	01	0.0	20.5	8.4	6.6	62	8.0	14.0	0.71	N.D.	0.02	0.09	5.0	2.0	44	1.5	5	<5
25-Jun-85	01	0.0	21.0	9.3	6.4	62	6.0	14.0	0.34	N.D.	0.08	0.03	5.0	1.0	56	1.6	10	<5
23-Jul-85	01	0.0	24.9	8.0	6.9	59	6.0	14.0	0.85	0.60	0.24	0.03	5.0	9.5	50	2.2	100	<5
19-Aug-85	01	0.0	24.3	8.2	7.3	57	13.0	12.0	0.41	N.D.	0.01	0.11	5.0	1.5	90	2.0	10000	10
18-Sep-85	01	0.0	19.2	8.6	6.4	60	11.0	13.0	0.72	N.D.	0.04	0.05	6.0	7.5	48	3.0	100	<5
15-Apr-86	01	0.0	11.7	11.8	6.9	44	6.0	10.0	0.26	0.30	0.04	0.06	4.0	1.5	40	3.6	--	<10
19-May-86	01	0.0	20.5	9.9	6.6	48	6.0	11.0	0.88	0.10	0.02	0.05	5.0	0.5	58	2.4	--	<5
03-Jun-86	01	0.0	20.2	9.1	6.6	51	7.0	12.0	0.48	0.10	0.19	0.06	5.0	2.5	40	2.6	--	10
17-Jun-86	01	0.0	20.8	9.0	7.0	47	7.0	12.0	0.67	0.20	0.03	0.05	3.0	1.0	36	1.6	--	5
07-Jul-86	01	0.0	23.9	9.2	7.2	45	10.0	14.0	0.62	0.20	0.10	0.12	3.0	2.5	46	2.0	--	<10
30-Jul-86	01	0.0	24.6	8.8	7.2	56	9.0	12.0	0.61	N.D.	0.05	0.05	4.0	1.5	38	2.2	--	--
11-Aug-86	01	0.0	24.6	7.9	6.4	53	10.0	15.0	0.31	N.D.	0.02	0.04	4.0	1.5	40	--	--	--
07-Oct-86	01	0.0	15.5	9.8	7.2	53	10.0	15.0	0.77	N.D.	N.D.	0.14	4.0	4.0	52	1.9	--	--
26-May-87	01	0.0	18.4	10.7	6.5	45	7.0	9.0	0.60	0.20	0.02	0.07	6.0	0.5	46	2.0	--	<5
21-Jul-87	01	0.0	25.0	8.6	6.7	62	9.0	14.0	0.67	N.D.	N.D.	0.06	4.9	1.0	150	1.6	--	<5
23-Sep-87	01	0.0	17.6	8.4	6.2	52	12.0	12.0	0.36	N.D.	0.03	0.04	5.0	4.5	20	1.8	--	--
28-Mar-88	01	0.0	6.0	11.5	6.7	68	8.0	17.0	0.34	0.40	N.D.	0.07	6.0	1.0	44	--	--	--
06-Jul-88	01	0.0	23.9	8.0	6.1	62	12.0	18.0	0.66	N.D.	0.05	0.06	5.0	N.D.	36	3.0	--	--
04-Apr-89	01	0.0	7.1	11.7	6.9	71	15.0	15.0	0.98	0.30	N.D.	0.03	7.0	3.5	46	--	--	--
09-Aug-89	01	0.0	24.8	8.8	6.1	66	11.0	14.0	0.55	N.D.	N.D.	0.09	6.9	1.5	52	2.1	--	<10
04-Aug-82	01	3.0	22.8	4.2	5.8	55	10.0	15.0	0.50	N.D.	0.03	0.07	4.0	5.0	66	--	--	--
04-Aug-82	01	4.0	18.7	0.6	5.7	76	12.0	14.0	0.51	N.D.	0.14	0.08	4.0	6.0	70	--	--	--

N.D.= Below Detection Limit

DATE	STATION	SAMPLE DEPTH	TEMP	DO	PH	SPEC. COND.	TOTAL ALK.	TOTAL HARD.	TKN	NITRATE	AMMONIA	TOTAL PHOSPHATE	CHLORIDE	SUSPENDED SOLIDS	TOTAL SOLIDS	SECCHI DISC	TOTAL COLIFORM	FECAL COLIFORM
07-Sep-82	01	4.0	19.6	4.8	5.9	60	11.0	19.0	0.51	N.D.	0.05	0.12	5.0	3.0	48	--	--	--
06-Oct-82	01	4.0	16.4	6.8	6.6	48	12.0	17.0	0.82	N.D.	0.09	0.03	6.0	3.0	6	--	--	--
22-Nov-82	01	4.0	6.8	8.6	6.8	53	11.0	20.0	0.36	0.10	0.04	0.03	7.0	1.0	24	--	--	--
23-May-83	01	4.0	14.0	9.5	6.3	54	9.0	12.0	1.00	0.20	0.11	0.04	4.0	2.0	62	--	--	--
08-Jun-83	01	4.0	15.2	4.1	5.8	56	6.0	13.0	0.42	0.10	0.01	0.05	1.0	1.0	20	--	--	--
06-Jul-83	01	4.0	18.9	0.4	5.8	68	9.0	14.0	0.45	N.D.	0.02	0.06	3.0	0.5	24	--	--	--
04-Aug-83	01	4.0	23.8	4.3	5.6	52	11.0	16.0	0.41	N.D.	0.01	0.05	4.0	3.0	52	--	--	--
19-Sep-83	01	3.0	20.4	7.7	6.3	48	11.0	14.0	0.87	N.D.	0.01	0.05	5.0	1.5	14	--	--	--
10-Apr-84	01	4.0	6.4	11.0	6.0	44	7.0	12.0	0.15	0.20	0.03	0.11	3.0	1.0	40	--	--	--
02-May-84	01	3.5	12.8	9.9	6.2	49	3.0	12.0	1.00	0.20	0.01	0.03	4.0	0.5	8	--	--	--
17-Jul-84	01	4.0	19.1	1.0	5.8	54	10.0	14.0	0.42	N.D.	0.05	0.05	3.0	3.0	62	--	--	--
06-Sep-84	01	4.0	19.9	6.7	5.7	54	12.0	8.0	1.60	0.20	0.06	0.05	5.0	9.5	42	--	--	--
25-Mar-85	01	4.0	--	--	--	--	8.0	15.0	0.50	0.30	0.04	0.05	6.0	7.5	58	--	--	--
30-Apr-85	01	4.0	13.3	9.5	6.0	61	--	--	0.86	0.20	0.01	0.04	--	--	--	--	--	--
30-May-85	01	3.5	18.4	8.4	6.1	62	9.0	15.0	0.60	0.10	N.D.	0.06	5.0	1.5	64	--	--	--
25-Jun-85	01	4.0	19.2	2.6	5.8	64	9.0	15.0	0.59	0.10	0.12	0.05	4.0	2.0	48	--	--	--
23-Jul-85	01	4.0	21.1	0.8	5.8	63	13.0	16.0	0.72	0.10	0.29	0.05	5.0	2.0	56	--	--	--
19-Aug-85	01	3.5	23.5	6.6	6.5	56	10.0	12.0	0.55	N.D.	N.D.	0.05	5.0	1.5	42	--	--	--
18-Sep-85	01	4.0	17.5	6.1	5.8	59	8.0	13.0	0.81	0.10	0.06	0.02	6.0	9.5	44	3.0	--	--
15-Apr-86	01	4.0	8.9	11.6	6.7	43	3.0	10.0	0.27	0.30	0.04	0.05	4.0	5.5	60	--	--	--
19-May-86	01	4.0	14.9	9.1	5.0	46	6.0	11.0	1.50	0.10	0.04	0.06	5.0	2.5	34	--	--	--
03-Jun-86	01	4.0	17.6	6.0	6.2	52	8.0	11.0	0.75	0.10	0.06	0.06	5.0	2.0	40	--	--	--
17-Jun-86	01	4.0	17.1	6.8	6.3	46	7.0	11.0	0.52	0.20	0.06	0.04	3.0	1.5	38	--	--	--
07-Jul-86	01	4.0	19.6	5.3	6.1	46	8.0	11.0	0.44	N.D.	0.05	0.05	3.0	2.0	58	--	--	--
30-Jul-86	01	4.0	20.8	0.4	5.4	71	13.0	11.0	0.70	N.D.	0.10	0.06	4.0	3.0	46	--	--	--
11-Aug-86	01	4.0	22.6	1.9	5.4	55	11.0	13.0	0.30	N.D.	0.04	0.03	4.0	0.5	44	--	--	--
07-Oct-86	01	4.0	15.5	9.5	7.6	53	6.0	21.0	0.76	0.20	0.07	0.20	4.0	5.0	46	--	--	--
26-May-87	01	4.0	16.0	12.2	5.9	45	6.0	9.0	0.53	0.20	0.03	0.03	6.0	0.5	36	--	--	--
21-Jul-87	01	4.0	22.4	1.0	6.3	68	13.0	13.0	0.64	N.D.	0.02	0.05	4.4	12.0	110	--	--	--
23-Sep-87	01	4.0	17.1	6.6	6.0	51	11.0	13.0	0.68	N.D.	0.02	0.04	4.0	5.0	30	--	--	--
28-Mar-88	01	4.0	5.4	11.1	6.6	68	3.0	18.0	0.48	0.40	N.D.	0.08	6.0	2.0	44	--	--	--
06-Jul-88	01	4.0	20.7	6.6	5.4	63	10.0	16.0	1.00	N.D.	N.D.	0.02	5.0	N.D.	40	--	--	--
04-Apr-89	01	4.0	6.9	11.4	6.5	69	--	--	--	--	--	--	--	--	--	--	--	--
09-Aug-89	01	4.0	23.9	1.0	5.8	69	15.0	16.0	0.58	0.09	N.D.	0.09	7.0	2.5	54	--	--	--
04-Aug-82	02	0.0	20.8	7.2	5.8	58	10.0	14.0	0.51	0.20	0.04	0.05	4.0	0.5	52	--	--	--
07-Sep-82	02	0.0	16.8	9.1	5.5	60	11.0	18.0	0.34	N.D.	0.05	0.14	5.0	1.0	46	--	60	10
06-Oct-82	02	0.0	13.9	8.6	7.1	55	10.0	19.0	0.33	N.D.	0.02	0.01	4.0	N.D.	N.D.	--	<10	<5

N.D.= Below Detection Limit

DATE	STATION	SAMPLE DEPTH	TEMP	DO	PH	SPEC. COND.	TOTAL ALK.	TOTAL HARD.	TKN	NITRATE	AMMONIA	TOTAL PHOSPHATE	CHLORIDE	SUSPENDED SOLIDS	TOTAL SOLIDS	SECCHI DISC	TOTAL COLIFORM	FECAL COLIFORM
22-Nov-82	02	0.0	8.0	9.7	6.7	61	10.0	20.0	0.38	0.10	0.02	0.03	8.0	N.D.	14	--	150	5
07-Dec-82	02	0.0	7.1	11.1	5.8	49	30.0	20.0	0.34	0.20	0.11	0.08	5.0	N.D.	32	--	--	--
12-Jan-83	02	0.0	2.3	13.1	6.2	45	8.0	20.0	0.55	1.00	0.19	0.10	6.0	2.5	42	--	1000	100
22-Feb-83	02	0.0	1.6	12.3	7.4	56	6.0	13.0	0.50	0.60	0.49	0.04	0.0	2.0	70	--	--	--
23-Mar-83	02	0.0	2.7	11.8	5.6	43	60.0	9.0	0.45	0.30	0.07	0.06	4.0	0.5	36	--	60	20
23-May-83	02	0.0	15.3	9.7	5.7	54	6.0	13.0	1.30	0.40	0.25	0.06	4.0	2.4	64	--	1000	480
08-Jun-83	02	0.0	16.7	9.4	5.2	60	10.0	14.0	0.63	0.10	0.04	0.04	1.0	1.5	24	--	240	20
06-Jul-83	02	0.0	21.0	7.3	5.9	69	9.0	14.0	0.58	0.10	0.02	0.07	3.0	1.0	44	--	10000	800
04-Aug-83	02	0.0	24.5	8.3	5.6	56	11.0	17.0	0.49	N.D.	0.02	0.04	4.0	8.5	56	--	2400	420
19-Sep-83	02	0.0	16.6	9.7	6.3	53	11.0	15.0	1.10	N.D.	0.20	0.03	4.0	1.0	6	--	60	30
18-Oct-83	02	0.0	10.7	9.3	5.9	48	14.0	15.0	--	--	--	--	5.0	N.D.	4	--	--	--
21-Nov-83	02	0.0	7.2	10.6	6.5	55	10.0	14.0	0.95	0.20	0.02	0.06	6.0	1.0	60	--	240	40
10-Jan-84	02	0.0	1.2	13.8	6.1	55	30.0	15.0	0.65	0.50	0.04	0.05	6.0	0.5	28	--	<10	<5
02-Feb-84	02	0.0	0.1	12.6	6.2	65	18.0	15.0	0.68	0.50	0.09	0.14	6.0	2.0	48	--	<10	<5
21-Feb-84	02	0.0	2.4	14.1	5.8	47	2.0	13.0	0.47	0.30	0.04	0.07	5.0	6.5	42	--	40	<5
05-Mar-84	02	0.0	1.7	12.6	5.8	47	7.0	13.0	0.41	0.30	0.02	0.08	4.0	0.5	40	--	--	--
10-Apr-84	02	0.0	5.6	11.4	5.9	42	7.0	10.0	0.15	0.20	0.03	0.09	3.0	1.0	36	--	--	--
02-May-84	02	0.0	10.6	10.5	5.8	50	2.0	13.0	0.74	0.40	0.01	0.04	4.0	1.0	4	--	--	--
17-Jul-84	02	0.0	20.1	8.5	5.9	59	10.0	16.0	0.50	0.20	0.02	0.04	4.0	1.0	78	--	1000	320
06-Sep-84	02	0.0	14.0	8.2	5.4	61	12.0	10.0	1.90	2.00	0.65	0.04	4.0	8.5	52	--	--	--
10-Oct-84	02	0.0	11.4	8.8	5.6	60	15.0	17.0	0.26	N.D.	0.02	0.06	4.0	12.0	78	--	40	<5
01-Nov-84	02	0.0	9.6	11.3	6.6	58	10.0	18.0	0.43	N.D.	N.D.	0.06	4.0	3.0	66	--	<10	<5
04-Dec-84	02	0.0	1.6	13.6	7.8	53	5.0	15.0	1.60	0.20	0.06	0.08	5.0	3.0	50	--	80	<5
16-Jan-85	02	0.0	0.1	13.3	6.3	60	10.0	--	0.44	0.30	0.09	0.05	4.0	2.0	60	--	--	--
25-Mar-85	02	0.0	3.5	12.7	7.1	55	8.0	14.0	0.69	0.30	0.01	0.06	5.0	6.5	46	--	<10	<10
30-Apr-85	02	0.0	13.8	9.0	5.7	60	4.0	15.0	0.77	0.10	0.01	0.04	5.0	5.0	48	--	20	10
30-May-85	02	0.0	15.8	8.8	6.4	60	9.0	14.0	0.55	0.10	N.D.	0.09	5.0	1.0	42	--	60	30
25-Jun-85	02	0.0	16.3	9.0	5.8	57	8.0	13.0	0.32	0.10	0.05	0.02	4.0	0.5	62	--	280	120
23-Jul-85	02	0.0	20.2	5.7	6.2	58	13.0	13.0	0.62	0.40	0.20	0.06	4.0	3.0	56	--	400	50
19-Aug-85	02	0.0	19.7	7.4	6.6	54	10.0	10.0	0.37	N.D.	0.01	0.09	5.0	3.0	34	--	40	<10
18-Sep-85	02	0.0	14.8	8.3	6.1	58	9.0	11.0	0.57	0.10	0.03	0.02	6.0	5.5	46	--	80	<5
29-Oct-85	02	0.0	5.8	11.4	5.7	52	9.0	13.0	0.62	0.20	0.01	0.07	6.0	4.5	76	--	100	5
23-Dec-85	02	0.0	0.1	13.0	6.4	52	8.0	17.0	0.73	0.40	0.04	0.10	7.0	5.5	62	--	20	<10
30-Jan-86	02	0.0	0.1	14.3	7.0	46	6.0	8.0	0.58	0.40	0.08	0.08	4.0	7.5	60	--	--	--
12-Feb-86	02	0.0	0.0	12.4	5.6	68	13.0	8.0	0.50	0.40	0.06	0.07	5.0	5.5	48	--	--	--
15-Apr-86	02	0.0	8.9	11.6	6.4	44	4.0	10.0	0.37	0.20	0.05	0.04	4.0	4.0	52	--	--	--
19-May-86	02	0.0	19.9	8.3	6.7	52	6.0	11.0	1.30	0.20	0.12	0.05	5.0	0.5	40	--	--	10

N.D.= Below Detection L

DATE	STATION	SAMPLE DEPTH	TEMP	DO	PH	SPEC. COND.	TOTAL ALK.	TOTAL HARD.	TKN	NITRATE	AMMONIA	TOTAL PHOSPHATE	CHLORIDE	SUSPENDED SOLIDS	TOTAL SOLIDS	SECCHI DISC	TOTAL COLIFORM	FECAL COLIFORM
03-Jun-86	02	0.0	15.0	11.3	6.3	50	9.0	11.0	0.47	0.10	0.03	0.05	5.0	2.5	46	--	--	50
17-Jun-86	02	0.0	17.8	9.4	6.5	47	8.0	12.0	0.43	0.20	0.03	0.05	3.0	N.D.	40	--	--	50
07-Jul-86	02	0.0	21.0	7.9	6.2	47	9.0	10.0	0.39	N.D.	0.15	0.05	3.0	N.D.	58	--	--	10
30-Jul-86	02	0.0	21.1	6.0	6.1	58	10.0	9.0	0.48	0.80	0.40	0.05	4.0	1.5	36	--	--	--
11-Aug-86	02	0.0	21.8	8.6	6.1	56	11.0	13.0	0.37	N.D.	0.02	0.03	4.0	0.5	46	--	--	--
07-Oct-86	02	0.0	9.5	11.3	8.2	56	10.0	24.0	0.60	0.10	0.13	0.10	5.0	2.0	44	--	--	--
12-Nov-86	02	0.0	2.5	16.5	6.4	62	11.0	25.0	0.94	0.20	0.05	0.02	6.0	0.5	58	--	--	--
17-Dec-86	02	0.0	1.7	13.8	6.4	62	8.0	5.0	0.94	0.40	0.04	0.12	7.0	3.0	58	--	--	<10
12-Jan-87	02	0.0	0.8	15.4	6.2	55	2.0	15.0	0.26	0.50	0.04	0.04	7.0	3.5	72	--	--	--
11-Feb-87	02	0.0	0.1	15.1	6.9	59	9.0	16.0	0.51	0.50	0.05	0.03	6.0	N.D.	60	--	--	--
17-Mar-87	02	0.0	0.6	13.8	7.2	62	7.0	7.0	0.32	0.60	0.06	0.02	7.0	1.0	90	--	--	<10
26-May-87	02	0.0	15.0	10.1	6.1	47	7.0	9.0	0.71	0.20	0.03	0.04	6.0	N.D.	48	--	--	40
21-Jul-87	02	0.0	24.0	7.9	6.4	60	13.0	13.0	0.57	0.10	0.03	0.04	4.0	N.D.	34	--	--	80
23-Sep-87	02	0.0	14.8	9.1	5.6	62	10.0	14.0	0.44	0.10	N.D.	0.02	5.0	1.0	40	--	--	--
17-Nov-87	02	0.0	3.9	13.2	5.9	56	6.0	16.0	0.64	0.30	0.03	0.02	7.0	1.0	52	--	--	--
11-Jan-88	02	0.0	0.0	14.4	7.3	73	10.0	14.0	0.50	0.40	0.06	0.10	6.0	N.D.	52	--	--	<5
28-Mar-88	02	0.0	3.5	12.2	6.5	60	6.0	15.0	0.36	0.30	0.02	0.08	5.0	1.0	42	--	--	--
06-Jul-88	02	0.0	20.4	5.6	5.4	60	10.0	19.0	0.70	N.D.	0.23	0.03	4.0	1.5	36	--	--	5
04-Apr-89	02	0.0	6.1	11.1	6.7	67	14.0	14.0	0.45	0.40	0.02	0.11	6.0	2.0	50	--	--	--
09-Aug-89	02	0.0	18.2	8.0	5.8	66	11.0	14.0	0.49	0.13	N.D.	0.08	6.8	N.D.	48	--	--	10
04-Aug-82	03	0.0	24.7	8.0	5.8	55	9.0	15.0	0.64	0.10	0.01	0.04	3.0	1.5	62	--	--	--
07-Sep-82	03	0.0	20.7	9.0	5.5	60	11.0	19.0	0.53	N.D.	0.04	0.13	7.0	3.0	66	--	20	20
06-Oct-82	03	0.0	17.3	8.3	6.8	49	12.0	17.0	0.63	0.20	0.16	0.01	4.0	N.D.	2	--	<10	<5
22-Nov-82	03	0.0	7.4	7.9	6.8	42	10.0	18.0	0.47	0.00	0.04	0.03	6.0	1.0	28	--	30	10
07-Dec-82	03	0.0	7.1	10.5	5.9	45	20.0	18.0	0.32	0.20	0.10	0.08	5.0	2.0	40	--	--	--
12-Jan-83	03	0.0	2.8	13.4	6.1	49	8.0	14.0	0.52	0.20	0.01	0.11	6.0	1.0	46	--	20	<5
22-Feb-83	03	0.0	2.5	10.4	7.2	51	6.0	12.0	0.35	0.50	0.28	0.03	--	2.0	40	--	--	--
23-Mar-83	03	0.0	4.6	10.0	5.6	46	60.0	11.0	0.33	0.30	0.04	0.07	5.0	2.5	40	--	140	<10
23-May-83	03	0.0	15.8	10.2	5.3	57	5.0	14.0	0.64	0.10	0.06	0.04	7.0	3.2	44	--	20	<5
08-Jun-83	03	0.0	19.7	9.8	5.1	56	10.0	13.0	0.51	N.D.	0.01	0.06	3.0	1.0	26	--	20	<5
06-Jul-83	03	0.0	25.8	7.7	6.3	66	9.0	14.0	0.57	N.D.	0.03	0.04	3.0	2.0	20	--	1600	130
04-Aug-83	03	0.0	26.0	8.0	5.5	51	11.0	14.0	0.32	N.D.	0.01	0.02	3.0	2.5	56	--	1200	60
19-Sep-83	03	0.0	21.2	7.9	6.1	48	12.0	15.0	0.77	N.D.	0.03	0.02	5.0	N.D.	2	--	400	10
18-Oct-83	03	0.0	13.8	9.5	5.8	45	8.0	14.0	--	--	--	--	4.0	1.0	2	--	--	--
21-Nov-83	03	0.0	5.1	11.5	6.3	50	8.0	13.0	0.73	0.10	0.03	0.07	5.0	3.0	42	--	480	30
10-Jan-84	03	0.0	2.4	13.0	6.1	59	6.0	16.0	1.20	1.40	1.10	0.10	6.0	N.D.	30	--	60	<5
02-Feb-84	03	0.0	2.4	11.9	6.3	62	18.0	15.0	0.46	0.50	0.08	0.05	6.0	0.5	30	--	<10	<5

N.D.= Below Detection Limit

DATE	STATION	SAMPLE DEPTH	TEMP	DO	PH	SPEC. COND.	TOTAL ALK.	TOTAL HARD.	TKN	NITRATE	AMMONIA	TOTAL PHOSPHATE	CHLORIDE	SUSPENDED SOLIDS	TOTAL SOLIDS	SECCHI DISC	TOTAL COLIFORM	FECAL COLIFORM
21-Feb-84	03	0.0	3.4	13.5	5.9	57	4.0	14.0	0.38	0.60	0.05	0.05	5.0	3.0	44	--	5	<5
05-Mar-84	03	0.0	3.9	12.1	5.8	52	5.0	13.0	0.45	0.30	0.02	0.09	4.0	0.5	36	--	--	--
10-Apr-84	03	0.0	7.0	11.6	5.5	46	--	--	0.24	0.30	0.03	0.05	--	--	--	--	--	--
02-May-84	03	0.0	12.9	10.7	5.6	49	7.0	12.0	0.77	0.20	0.01	0.11	6.0	0.5	4	--	--	--
17-Jul-84	03	0.0	25.1	8.5	6.6	50	8.0	13.0	0.42	0.10	0.09	0.03	3.0	2.0	56	--	100	10
06-Sep-84	03	0.0	20.5	7.2	5.4	55	12.0	7.0	1.90	0.20	0.12	0.04	--	7.5	46	--	--	--
10-Oct-84	03	0.0	13.3	10.0	5.8	52	10.0	14.0	0.31	0.10	0.01	0.05	3.0	20.0	62	--	20	<5
01-Nov-84	03	0.0	12.5	12.1	6.7	55	9.0	15.0	0.68	N.D.	0.01	0.05	4.0	5.0	68	--	10	<5
04-Dec-84	03	0.0	3.2	12.7	7.9	51	6.0	15.0	1.20	0.10	0.03	0.08	5.0	6.0	64	--	40	<5
16-Jan-85	03	0.0	2.5	12.3	6.5	65	10.0	--	0.39	0.50	0.13	0.05	5.0	3.0	56	--	--	--
25-Mar-85	03	0.0	4.5	14.0	7.5	56	15.0	15.0	0.58	0.30	0.03	0.05	6.0	6.5	50	--	110	20
30-Apr-85	03	0.0	14.9	9.4	6.0	62	6.0	15.0	0.63	0.80	0.05	0.04	6.0	5.0	30	--	<20	<10
30-May-85	03	0.0	20.2	8.3	6.6	62	9.0	16.0	0.68	0.10	N.D.	0.09	5.0	3.0	32	--	10	<5
25-Jun-85	03	0.0	20.9	9.6	6.4	61	7.0	14.0	0.55	N.D.	0.03	0.03	4.0	1.5	48	--	60	<5
23-Jul-85	03	0.0	24.5	8.0	6.9	60	7.0	17.00	0.63	N.D.	0.20	0.04	5.0	3.5	44	--	60	<5
19-Aug-85	03	0.0	24.3	7.8	7.3	56	10.0	15.0	0.41	N.D.	0.02	0.08	5.0	1.5	38	--	8000	<10
18-Sep-85	03	0.0	19.7	9.9	6.4	60	7.0	13.0	0.56	N.D.	0.09	0.01	6.0	8.5	38	--	20	<5
29-Oct-85	03	0.0	9.9	10.5	6.2	55	5.0	14.0	0.57	0.20	0.02	0.07	5.0	4.5	80	--	20	<5
23-Dec-85	03	0.0	2.5	12.2	6.6	58	10.0	17.0	0.72	1.00	0.11	0.14	7.0	6.0	64	--	<20	<10
30-Jan-86	03	0.0	1.7	14.1	6.9	51	6.0	9.0	0.49	0.40	0.10	0.09	5.0	9.0	54	--	--	--
12-Feb-86	03	0.0	0.5	12.6	5.6	64	12.0	8.0	0.53	0.40	0.12	0.07	5.0	6.0	40	--	--	--
15-Apr-86	03	0.0	11.6	11.8	6.7	44	5.0	10.0	0.36	0.30	0.05	0.12	4.0	3.5	54	--	--	--
19-May-86	03	0.0	20.0	9.5	7.0	48	5.0	11.0	0.98	0.20	0.08	0.05	4.0	N.D.	40	--	--	<5
03-Jun-86	03	0.0	20.4	9.4	6.8	51	7.0	12.0	0.51	0.10	0.23	0.04	5.0	1.5	40	--	--	30
17-Jun-86	03	0.0	20.6	9.4	6.8	47	7.0	12.0	0.48	0.20	0.02	0.05	3.0	1.5	38	--	--	10
07-Jul-86	03	0.0	23.5	9.3	6.9	45	9.0	10.0	0.40	N.D.	0.03	0.05	3.0	0.5	52	--	--	60
30-Jul-86	03	0.0	24.7	8.5	7.2	57	9.0	10.0	0.57	N.D.	N.D.	0.02	4.0	1.0	40	--	--	--
11-Aug-86	03	0.0	24.4	8.5	6.4	53	10.0	14.0	0.41	N.D.	N.D.	0.03	3.0	0.5	40	--	--	--
07-Oct-86	03	0.0	15.8	9.5	7.3	53	8.0	33.0	0.52	N.D.	N.D.	0.09	4.0	3.0	45	--	--	--
12-Nov-86	03	0.0	7.2	14.5	6.7	54	10.0	18.0	0.66	0.10	0.02	0.05	5.0	2.5	44	--	--	--
17-Dec-86	03	0.0	2.0	14.2	6.8	54	7.0	4.0	0.74	0.20	0.07	0.09	5.0	4.0	48	--	--	20
12-Jan-87	03	0.0	2.8	15.0	6.0	52	3.0	17.0	0.28	0.40	0.02	0.03	8.0	4.0	58	--	--	--
11-Feb-87	03	0.0	1.1	13.9	6.2	60	8.0	17.0	0.44	0.50	0.06	0.04	6.0	N.D.	50	--	--	--
17-Mar-87	03	0.0	2.2	14.1	7.2	62	8.0	10.0	0.38	0.50	0.06	0.02	7.0	1.5	94	--	--	<10
26-May-87	03	0.0	18.9	10.6	6.3	46	7.0	9.0	0.93	0.20	N.D.	0.05	6.0	0.5	50	--	--	10
21-Jul-87	03	0.0	25.5	9.0	6.7	61	11.0	14.0	0.86	N.D.	N.D.	0.03	4.4	1.0	96	--	--	--
23-Sep-87	03	0.0	17.8	8.8	6.4	52	10.0	14.0	0.40	N.D.	0.02	0.03	5.0	6.0	30	--	--	--

N.D.= Below Detection Limit

DATE	STATION	SAMPLE DEPTH	TEMP	DO	PH	SPEC. COND.	TOTAL ALK.	TOTAL HARD.	TKN	NITRATE	AMMONIA	TOTAL PHOSPHATE	CHLORIDE	SUSPENDED SOLIDS	TOTAL SOLIDS	SECCHI DISC	TOTAL COLIFORM	FECAL COLIFORM
17-Nov-87	03	0.0	4.6	13.2	6.8	52	5.0	17.0	0.82	0.30	0.03	0.04	7.0	4.5	40	--	--	--
11-Jan-88	03	0.0	2.3	14.2	7.1	80	8.0	14.0	0.68	0.30	0.02	0.10	7.0	N.D.	52	--	--	<5
28-Mar-88	03	0.0	6.3	11.5	6.8	70	6.0	17.0	0.52	0.40	N.D.	0.07	6.0	1.0	38	--	--	--
06-Jul-88	03	0.0	24.0	7.6	6.2	63	10.0	14.0	0.50	N.D.	N.D.	0.02	4.0	1.0	36	--	--	<5
04-Apr-89	03	0.0	7.2	11.4	7.0	71	38.0	15.0	0.49	0.30	N.D.	0.09	7.0	N.D.	66	--	--	--
09-Aug-89	03	0.0	25.1	7.3	6.1	66	11.0	15.0	0.49	N.D.	N.D.	0.10	7.0	1.0	48	--	--	20

N.D.= Below Detection Limit

APPENDIX X

Massachusetts Surface Water Quality Standards

314 CMR 4.00: MASSACHUSETTS SURFACE WATER QUALITY STANDARDS

Section

4.01: General Provisions

(1) Title. 314 CMR 4.00 shall be known as the "Massachusetts Surface Water Quality Standards."

(2) Organization of Standards. These standards comprise five (5) units: General Provisions (314 CMR 4.01), Application of Standards (314 CMR 4.02), Water Quality Criteria (314 CMR 4.03), Antidegradation Provisions (314 CMR 4.04), and Basin Classifications and Maps (314 CMR 4.05).

(3) Authority. The Massachusetts Surface Water Quality Standards are adopted by the Division pursuant to the provisions of M.G.L. c. 21, s. 27.

(4) Purpose. The Massachusetts Act charges the Division with the duty and responsibility to enhance the quality and value of the water resources of the Commonwealth and directs the Division to take all action necessary or appropriate to secure to the Commonwealth the benefits of the Federal Act. The objective of the Federal Act is the restoration and maintenance of the chemical, physical and biological integrity of the Nation's waters. To achieve the foregoing requirements the Division has adopted the Massachusetts Water Quality Standards which designate the uses for which the various waters of the Commonwealth shall be enhanced, maintained and protected; which prescribe the water quality criteria required to sustain the designated uses; and which contain regulations necessary to achieve the designated uses and maintain existing water quality including, where appropriate, the prohibition of discharges.

(5) Definitions. As used in these standards, the following words have the following meanings:

Artificial conditions - Those conditions resulting from human alteration of the chemical, physical or biological integrity of waters.

Beneficial use - Any use not impairing the most sensitive use designated in the classification tables contained in 314 CMR 4.05; except that in no case shall the assimilation or transport of pollutants be deemed a beneficial use.

Cold water fishery - Waters whose quality is capable of sustaining a year-round population of cold water trout (salmonidae).

Division - The Massachusetts Division of Water Pollution Control, as established by M.G.L. c. 21, s. 26.

Discharge - Any addition of any pollutant to the waters of the Commonwealth.

EPA - The United States Environmental Protection Agency.

Federal Act - The Federal Water Pollution Control Act, as amended, 33 U.S.C. s. 1251, et seq.

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APPROVED BY: State Purchasing Agent

4.01: continued

Massachusetts Act - The Massachusetts Clean Waters Act, as amended, M.G.L. c. 21, ss. 26 - 53.

Pollutant - Any element or property of sewage, agricultural, industrial or commercial waste, runoff, leachate, heated effluent, or other matter, in whatever form and whether originating at a point or major nonpoint source, which is or may be discharged, drained or otherwise introduced into any sewerage system, treatment works or waters of the Commonwealth.

Primary contact recreation - Any recreation or other water use, such as swimming and water skiing, in which there is prolonged and intimate contact with the water sufficient to constitute a health hazard.

Seasonal cold water fishery - Waters whose quality is capable of sustaining only an extremely limited cold water population on a year-round basis, with cold-water fish in these streams provided largely by stocking.

Secondary contact recreation - Any recreation or other water use in which contact with the water is either incidental or accidental, such as fishing, boating and limited contact incident to shoreline activities.

Segment - A finite portion of a water body established by the Division for the purpose of classification.

Surface waters - All waters other than ground waters within the jurisdiction of the Commonwealth, including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, and coastal waters.

Warm water fishery - Waters whose quality is not capable of sustaining a year-round cold water or seasonal cold water fishery.

Waters of the Commonwealth - All waters within the jurisdiction of the Commonwealth, including, without limitation, rivers, streams, lakes, ponds, springs, impoundments, estuaries, wetlands, coastal waters, and ground waters.

(6) Severability. If any provision of these standards is held invalid, the remainder of these standards shall not be affected thereby.

4.02: Application of Standards

(1) Establishment of Effluent Limitations. In regulating discharges of pollutants to surface waters, the Division will limit or prohibit such discharges to insure that the water quality standards of the receiving waters will be maintained or attained. The determination by the Division of the applicable level of treatment for an individual discharger will be made in the establishment of effluent limitations in the individual discharge permits in accordance with 314 CMR 3.10(3), (4), (5) and (6). In establishing water quality based effluent limitations, the Division must consider natural background conditions, existing discharges, must protect existing downstream uses, and not interfere with the maintenance and attainment of beneficial uses in downstream waters. Toward this end, the Division may provide a reasonable margin of safety to account for any lack of knowledge concerning the relationship between the pollutants being discharged and their impact on the quality of the receiving waters.

(2) Mixing Zones. In applying these standards, the Division may recognize, where appropriate, a limited mixing zone or zone of initial dilution on a case-by-case basis. The location, size and shape of these zones shall provide for the maximum protection aquatic resources. At a minimum, mixing zones must:

4.02: continued

(a) Meet the criteria for aesthetics;
(b) Be limited to an area or volume that will minimize interference with the designated uses or established community of aquatic life in the segment;
(c) Allow an appropriate zone of passage for migrating fish and other organisms; and
(d) Not result in substances accumulating in sediments, aquatic life or food chains to exceed known or predicted safe exposure levels for the health of humans or aquatic life.

(3) Hydrologic Conditions. The Division will determine the most severe hydrologic condition at which water quality standards must be met. In classifying the inland surface waters and in applying these standards to such waters, the critical low flow condition at and above which these standards must be met is the average minimum consecutive seven day flow to be expected once in ten years, unless otherwise stated by the Division in these standards. In artificially regulated waters, the critical low flow will be established by the Division through agreement with the Federal, State or private interest controlling the flow. The minimum flow established in such agreement will become the critical low flow under 314 CMR 4.02 for those waters covered by the agreement.

(4) Procedures for Sampling and Analysis. For the purpose of collecting, preserving and analyzing samples in connection with these water quality standards, the fifteenth edition of Standard Methods for the Examination of Water and Wastewater published by the American Public Health Association, or Methods for Chemical Analysis of Water and Wastes published by the U.S. Environmental Protection Agency should be used. Where a method is not given in these publications, the latest procedures of the American Society for Testing Materials (ASTM) shall be used, or any other equivalent method approved by the Director.

4.03: Minimum Water Quality Criteria and Associated Uses

(1) Description of Contents. 314 CMR 4.03 sets forth the Classes to be used by the Division in classifying the surface waters according to the uses for which the waters shall be enhanced, maintained and protected. For each class, the most sensitive beneficial uses are identified and minimum criteria for water quality in the water column are established. In interpreting and applying the minimum criteria in 314 CMR 4.03(4), the Division shall consider local conditions including, but not limited to:
(a) the characteristics of the biological community;
(b) temperature, weather, flow, and physical and chemical characteristics; and
(c) synergistic and antagonistic effects of combinations of pollutants.

(2) Coordination with Federal Criteria. The Division will use EPA criteria established pursuant to Section 304(a)(1) of the Federal Act as guidance in establishing case-by-case discharge limits for pollutants not specifically listed in these standards but included under the heading "Other Constituents" in 314 CMR 4.03(4), for identifying bioassay application factors and for interpretations of narrative criteria. Where the minimum criteria specifically listed by the Division in 314 CMR 4.03 differ from those contained in the federal criteria, the provisions of the specifically listed criteria in 314 CMR 4.03 shall apply.

(3) Classes and Designated Uses. The surface waters will be assigned to one of the classes listed below. Each class is defined by the most sensitive, and therefore governing, uses which it is intended to protect. The classes are:

4.03: continued

Classes for Inland Waters

Class A - Waters assigned to this class are designated for use as a source of public water supply.

Class B - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; and for primary and secondary contact recreation.

Class C - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; and for secondary contact recreation.

Classes for Coastal and Marine Waters

Class SA - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; for primary and secondary contact recreation; and for shellfish harvesting without depuration in approved areas.

Class SB - Waters assigned to this class are designated for the uses of protection and propagation of fish, other aquatic life and wildlife; for primary and secondary contact recreation; and for shellfish harvesting with depuration (Restricted Shellfish Areas).

Class SC - Waters assigned to this class are designated for the protection and propagation of fish, other aquatic life and wildlife; and for secondary contact recreation.

(4) Minimum Criteria. The following minimum criteria are adopted and shall be applicable to all surface waters.

A. These minimum criteria are applicable to all surface waters, unless criteria specified for individual classes are more stringent.

Parameter	Criteria
1. Aesthetics	All waters shall be free from pollutants in concentrations or combinations that: (a) Settle to form objectionable deposits; (b) Float as debris, scum or other matter to form nuisances; (c) Produce objectionable odor, color, taste or turbidity; or (d) Result in the dominance of nuisance species.
2. Radioactive Substances	Shall not exceed the recommended limits of the United States Environmental Protection Agency's National Drinking Water Regulations.
3. Tainting Substances	Shall not be in concentrations or combinations that produce undesirable flavors in the edible portions of aquatic organisms.
4. Color, Turbidity, Total Suspended Solids	Shall not be in concentrations of combinations that would exceed the recommended limits on the most sensitive receiving water use.
5. Oil and Grease	The water surface shall be free from floating oils, grease and petrochemicals and any concentrations or combinations in

4.03: continued

Parameter	Criteria
	the water column or sediments that are aesthetically objectionable or deleterious to the biota are prohibited. For oil and grease of petroleum origin the maximum allowable discharge concentration is 15 mg/l.
6. Nutrients	Shall not exceed the site-specific limits necessary to control accelerated or cultural eutrophication.
7. Other Constituents	Waters shall be free from pollutants in concentrations or combinations that (a) Exceed the recommended limits on the most sensitive receiving water use; (b) Injure, are toxic to, or produce adverse physiological or behavioral responses in humans or aquatic life; or (c) Exceed site-specific safe exposure levels determined by bioassay using sensitive species.

B. Inland Waters - the following additional minimum criteria are applicable to inland water classifications.

For Class A waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°c) in warm water fisheries or 68°F (20°c) in cold water fisheries nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°c).
3. pH	As naturally occurs.
4. Total Coliform Bacteria	Shall not exceed a log mean for a set of samples of 50 per 100 ml during any monthly sampling period.
5. Turbidity	None other than of natural origin.
6. Total Dissolved Solids	Shall not exceed 500 mg/l.
7. Chlorides	Shall not exceed 250 mg/l.
8. Sulfates	Shall not exceed 250 mg/l.
9. Nitrate	Shall not exceed 10 mg/l as nitrogen.

4.03: continued

For Class B waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°c) in warm water fisheries or 68°F (20°c) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°c).
3. pH	Shall be in the range of 6.5 - 8.0 standard units and not more than 0.2 units outside of the naturally occurring range.
4. Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 200 per 100 ml, nor shall more than 10% of the total samples exceed 400 per 100 ml during any monthly sampling period, except as provided in 314 CMR 4.02(1).

For Class C waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 5.0 mg/l in warm water fisheries and a minimum of 6.0 mg/l in cold water fisheries.
2. Temperature	Shall not exceed 83°F (28.3°c) in warm water fisheries or 68°F (20°c) in cold water fisheries, nor shall the rise resulting from artificial origin exceed 4.0°F (2.2°c).
3. pH	Shall be in the range of 6.5-9.0 standard units and not more than 0.2 units outside of the naturally occurring range.
4. Fecal Coliform Bacteria	Shall not exceed a log mean for a set of samples of 1000 per 100 ml, nor shall more than 10% of the total samples exceed 2,500 per 100 ml during any monthly sampling period, except as provided in 314 CMR 4.02(1).

C. Coastal and Marine Waters - the following additional minimum criteria are applicable to coastal and marine waters.

For Class SA waters:

Parameter	Criteria
1. Dissolved Oxygen	Shall be a minimum of 85 percent of saturation at water temperatures above 77°F (25°C) and shall be a minimum of 6.0 mg/l at water temperatures of 77°F (25°C) and below.

APPENDIX XI

Addendum: 1991 Post-Restoration Survey

Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Department of Environmental Protection

William F. Weld
Governor
Daniel S. Greenbaum
Commissioner

October 3, 1991

Richard Magwood, Chair
Conservation Commission
Depot Square
Town Hall
East Brookfield, MA 01515

Dear Mr. Magwood:

Re: Post-Restoration Survey of Lake Lashaway

As you requested, the Limnology Section ("Lakes Program") conducted a post-restoration survey of Lake Lashaway to re-evaluate the effectiveness of annual winter drawdowns. This included a baseline survey on August 7, a macrophyte survey on August 14, and a brief follow-up survey on August 20 to collect specimens of an atypical, but commonly occurring pondweed (Potamogeton sp.) that could not be identified with standard taxonomic keys. The latter specimens were pressed, dried, and mailed to Dr. Barre Hellquist, who subsequently identified them as Potamogeton bicupulatus, or "snailseed pondweed." Attachments to this letter include a list of plant species populations and their respective distributions in the lake, the percent of lake bottom covered by macrophytes (to the depth of visibility), bathymetric map, and chemical/physical data. This information should be examined with reference to The Restoration of Lake Lashaway report that I authored (Haynes 1990).

On the basis of the recent surveys I can state that the macrophyte community in the main body of the lake (i.e., excluding the north cove) is little different from that recorded by the Limnology Section on August 12, 1988 in terms of species composition (refer to attachment and Table 1 of Haynes 1990), relative abundance of species populations, and percent cover by the entire macrophyte community. Fanwort (Cabomba caroliniana), the major nuisance population prior to annual drawdowns, presently exhibits a very limited distribution in the main body of the lake. It is confined primarily to coves on the east and west shores at the latitude of the islands. However, fragments of Cabomba caroliniana were commonly observed floating on the lakes's surface, and these fragments can disperse the fanwort population to other suitable locations. The bushy pondweed (Najas flexilis) was a co-dominant nuisance plant prior to winter drawdowns, but its population has also been well controlled. Today, Najas flexilis occurs at scattered locations along the shoreline, in shallow water, but individual plants are quite small. The aforementioned observations are in stark contrast to the condition of Lake Lashaway in the summer of 1982 when these two macrophytes covered approximately 70% of the lake.

Another species of Najas, N. quadalupensis, was commonly collected from the deeper water of Lake Lashaway (approximate depth zone is 5 to 10 feet) during the recent survey. Its apparent preference for deeper water may protect this species population from freezing, desiccation, and compaction of the sediments during winter drawdown. Since these plants were collected mechanically with the aid of a "claw" their distribution is unknown, but they appear to form a bright green

carpet of elongated plants (in contrast to Najas flexilis) at the sediment-water interface. This is likely advantageous since these plants contribute to the diversity of this habitat and to the production of dissolved oxygen at the lake bottom. Najas guadalupensis was not recorded for Lake Lashaway during four previous surveys (1982, 1986, 1987, and 1988) conducted by the Limnology Section and it may have spread to, or been introduced to, the Lake since 1988. However, one or more of the following statements could also explain why this plant was not recorded previously: a) samples were not collected from deeper water; b) the plant was collected, but it was identified to genus only (i.e., Najas sp.); or c) the plant was misidentified as Najas flexilis. Statement b) is the more likely explanation since no species designations were assigned to Najas specimens collected from previous surveys.

Potamogeton bicupulatus is one of two macrophytes that was commonly observed along the Lake Lashaway shoreline during the August 1991 surveys, but few of these plants (approximately 5) exhibited the typical growth form (refer to attached copy of Figure 6 from Hellquist and Crow 1980). Most plants were diminutive and they proved difficult to identify as noted previously in this letter. I do not know if annual winter drawdowns adversely affects the growth form of this particular macrophyte. The tiny plant Elatine sp. (El-ah-tiny) is almost microscopic, but it too was common in shallow water. Although both of these plants were recorded in more than 60% of shoreline observations, neither was abundant and the combined biomass of the two populations would be quite small.

The north cove (north of the submerged roadbed) did exhibit a dense cover of macrophytes over much of its area in contrast to the main body of water. Most of this dense cover was below the water surface and it did not impede the use of our small motorboat. Cabomba caroliniana is the dominant macrophyte at this location, and it grows luxuriantly north of the Harrington Street bridge at the mouth of the Five Mile River. No doubt this latter site is the seed population for regrowth in the North cove. Also, boating activity at these two locations causes fragmentation of Cabomba caroliniana, and some of the fragments likely float or are otherwise transported to the main body of water as noted previously in this letter.

I have decided not to elaborate on the chemical and physical data included with this now lengthy letter, in part because the data are entirely consistent with the long-term Limnology Section monitoring database on Lake Lashaway that is provided in Appendix IX of Haynes (1990). Two items deserve brief mention, however. The near depletion of dissolved oxygen at the mud-water interface in "deep" water (5 meters or 16.5 feet) has been recorded previously, whereas the 4.1 mg D.O./Liter measured at 4 meters is relatively high compared to previous summers. And second, the Secchi disk reading of 2.8 meters (9 feet) is among the highest mid-summer measurements of water transparency since construction of the outlet control structure, and it occurred at a time when phytoplankton (algae) were visibly evident in the water column.

Based on the results of surveys conducted by the Limnology Section, I conclude that annual winter drawdown of Lake Lashaway has been an effective lake management method to control nuisance macrophytes. The main body of the lake has been essentially free of dense "weeds" for six sequential growing seasons and, to date, there is no indication that any macrophyte species population has exhibited accelerated growth and distribution in response to winter drawdowns. Another measure of success is the unsolicited comments by lake-side abutters (three) during the recent macrophyte survey. The gist of their collective statements is that this (1991) has been the "best year" since drawdown began and that the lake has not "looked this good" in a long time. Despite these

successes, I would advise a survey of the Lake Lashaway fish populations by the Division of Fisheries and Wildlife since this data will provide the conservation commission, Lake Lashaway Association, and the Limnology Section with a more holistic perspective on the effects of winter drawdown in this particular body of water.

Please telephone me at (617) 292-5954 if you have any concerns or questions about this letter or the enclosed data and maps.

Sincerely,

Robert C. Haynes

Robert C. Haynes, Ph.D.
Limnology Section

RCH:djm
Enclosures
BH10391

cc: R. Isaac
R. McVoy
C. O'Leary
L. Underwood
J. Bergin
P. Barstow
B. Munyon

Massachusetts Department of Environmental Quality Engineering
Division of Water Pollution Control • Technical Services Branch

LAKE SURVEY SHEET

TYPE OF SURVEY: POST-RESTORATION MONITORING

LAKE/~~POND/IMP~~. LASHAWAY — LOCATION E. BROOKFIELD/N. BROOKFIELD

DRAINAGE BASIN CHICOPEE RIVER — DATE AUGUST 7, 1991

COLLECTOR(S) HAYNES/NATHAN — SECCHI DISK:

WEATHER:

Time 2:00 - 2:12

Air Temperature 85°f — Transparency 2.8 m

Wind 5-10 mph — Water Surface ripples

Cloud Cover ~ 40% — Water Color yellow-green

	Sta. #	Depth (M)	Water Temp.(C)	pH	Dissolved Oxygen	Spec. Cond.	Metal Samples	Chemical Samples	Biological Samples	Other
	1	⊖	24.9	6.9	7.8	68		✓✓ ✓✓	(STA. 1 AND 1A)	
		1	24.8	6.8	7.8	68				
		2	23.8	6.7	7.7	67				
		3	23.5	6.6	7.7	67				
		4	22.9	6.7	4.1	70				
		5	22.0	5.8	0.6	77				
		5.2	BOTTOM							
		4.5						✓✓		
*	2	⊖	20.3	6.8	10.0	70		✓✓		
:30	3	⊖	26.1	7.0	7.8	68				

REMARKS: (*) 100% cover, primarily Cabomba caroliniana. Hence photosynthetic activity likely responsible for elevated D.O.

FLOW SHEETS ATTACHED: Station(s)

HYDROLAB: pH, temp., D.O., specific conductivity

LES: alkalinity, chloride, total coliform, fecal coliform, TS, SS, TKN, NO_3, NH_3, TP, Hardness (preserved with H_2SO_4)

THE COMMONWEALTH OF MASSACHUSETTS
DEPARTMENT OF ENVIRONMENTAL QUALITY ENGINEERING
LAWRENCE EXPERIMENT STATION

SEP 04 1991

WATER POLLUTION LABORATORY
(mg. per liter)

Lake Lashaway

Collector: Haynes/Nathan

SOURCE A North Brookfield, #1, surface
SOURCE B North Brookfield, #3 - 4.75 meters
SOURCE C North Brookfield, #1A
SOURCE D North Brookfield, #2, inlet

	A	B	C	D
SAMPLE NO.	R38260	R38261	R38262	R38263
DATE OF COLLECTION	08/07/91	08/07/91	08/07/91	08/07/91
TIME OF COLLECTION	2:10	2:25	2:15	2:50
DATE RECEIVED	08/08/91	08/08/91	08/08/91	08/08/91
COD				
BOD				
pH				
ALKALINITY, TOTAL	11	15	11	11
HARDNESS				
SUSPENDED SOLIDS	1.5	4.0	1.5	<1.0
SETT. SOLIDS ml/l				
TOTAL SOLIDS	40	46	44	44
TURBIDITY				
SPEC. CONDUCTIVITY				
TOT.VOL SOLIDS				
TOTAL KJELDAHL-N				
AMMONIA-N	<0.02	0.08	0.05	<0.02
NITRITE-N				
NITRATE-N	<0.02	<0.02	<0.02	0.05
TOTAL P	0.05	0.05	0.03	0.04
ORTHO-P				
TOTAL COLIFORM				
FECAL COLIFORM				
CHLORIDE				
PHENOL				
CYANIDE				
E. COLI				
PHTH ALKALINITY				
OIL & GREASE				

REMARKS

Figure 4.2-2 Bathymetric Map of Lake Lashaway

Source: Gunner and Rho, 1977

MACROPHYTE SURVEY LAKE LASHAWAY August 14, 1991

w2 Pontederia cordata

~~P. cordata f. lanceo~~ K Ceratophyllum demersum

F7 Gratiola lutea

n3 Cabomba caroliniana

n1 Brasenia schreberi

J2 Najas flexilis / J3 N. guadalupensis

e2 Eriocaulon septangulare

h3 Myriophyllum sp.

P4 Potamogeton robbinsii/(P5) P. epihydrous

P19 P. bicupulatus

A5 Sagittaria latifolia

S Sparganium sp.

Y2 Dulichium arundinaceum

R2 Elatine sp.

E1 Eleocharis acicularis

q3 Myosotis sp.

Q2 Polygonum sp.

f1 Sium suave Walt.

F4 Chelone sp.

V3 Ludwigia palustris

T Typha latifolia L.

C5 Nitella flexilis

C4 Nitella tenuissima

N5 Nuphar sp.

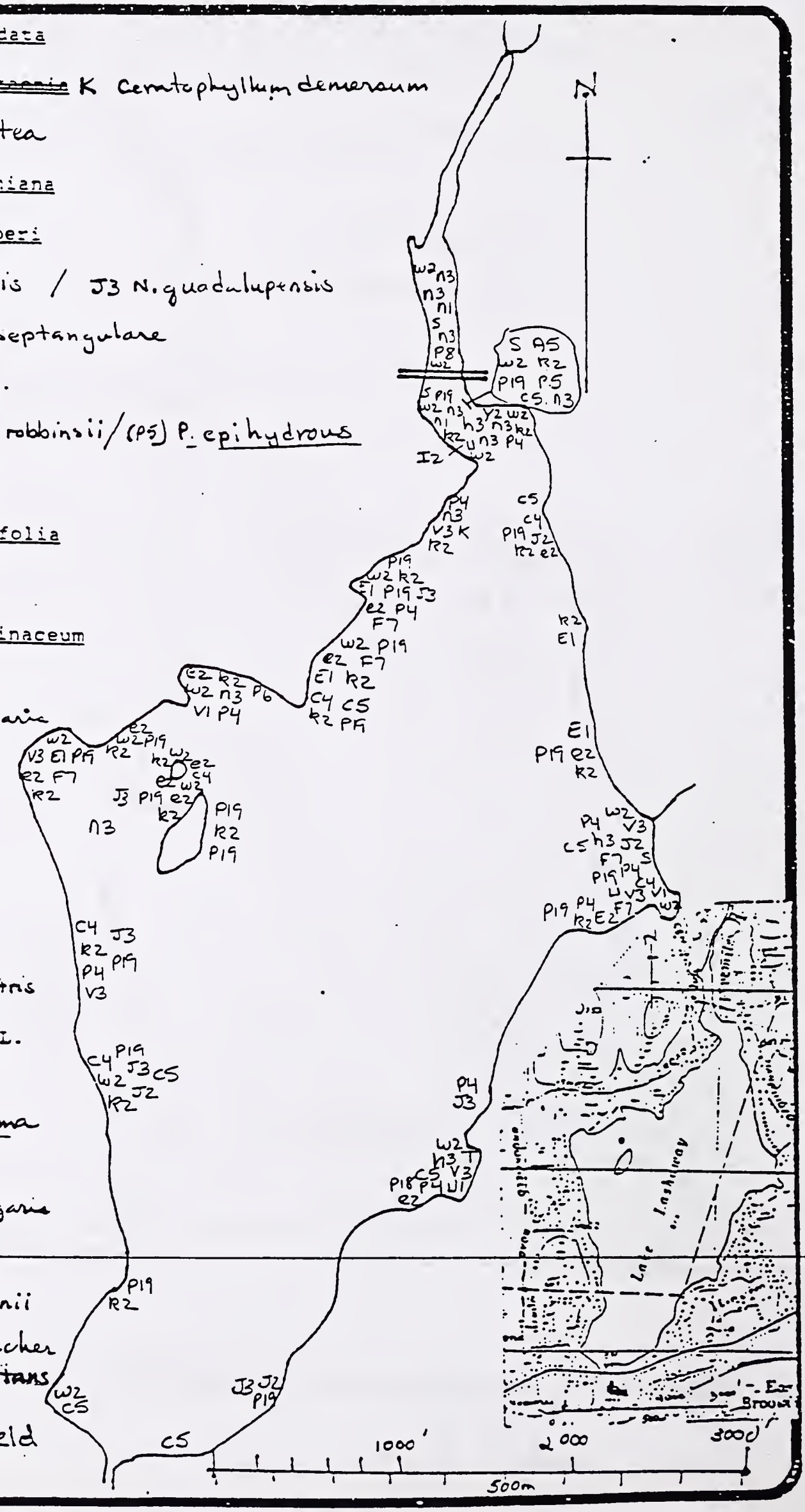
U1 Utricularia vulgaris

U Utricularia sp.

I2 Isoetes braunii

P18 Potamogeton pulcher

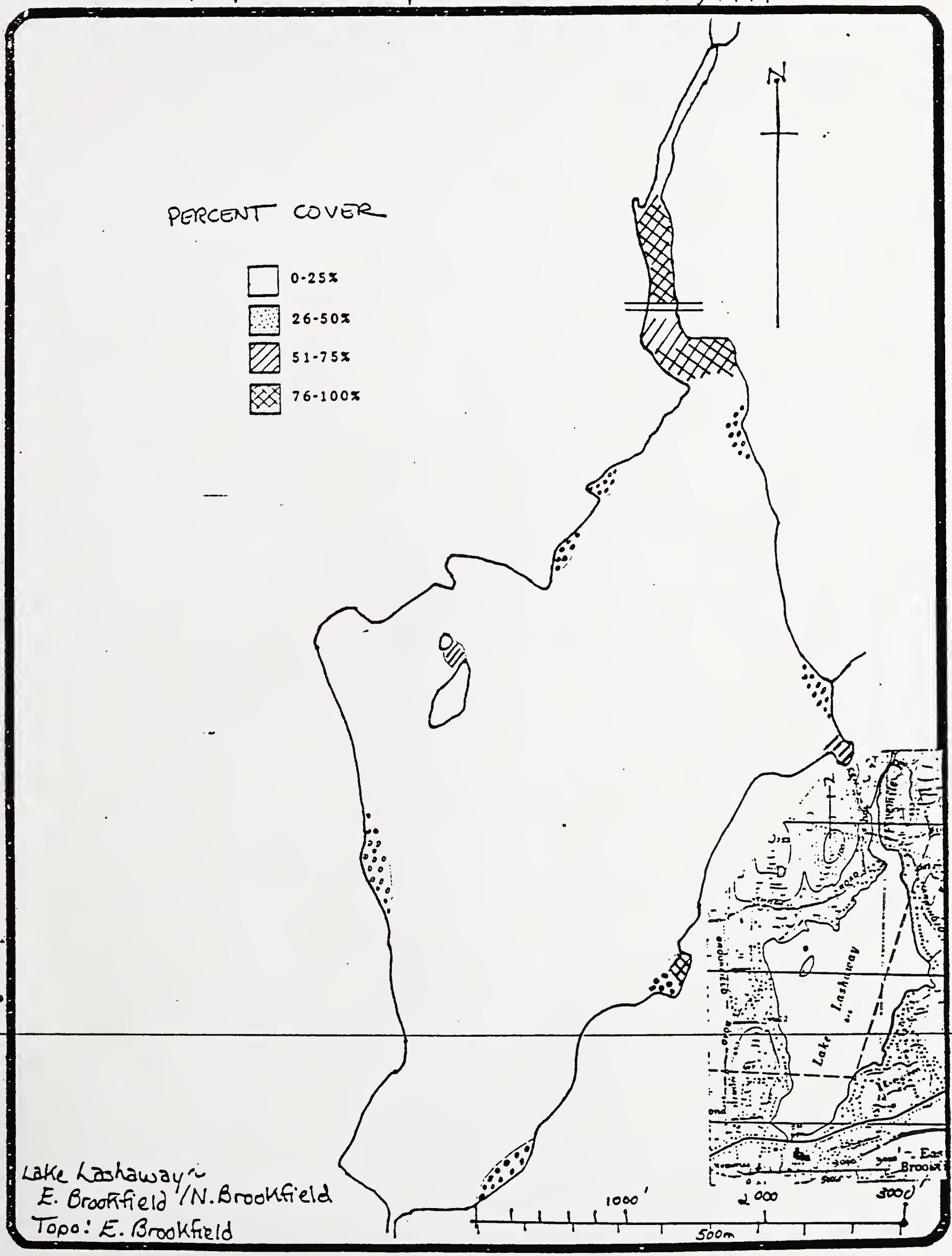
P8 Potamogeton natans



Lake Lashaway ~
E. Brookfield / N. Brookfield
Topo: E. Brookfield

I2 Isoetes braunii

MACROPHYTE SURVEY AUGUST 14, 1991



Lake Lashaway
E. Brookfield / N. Brookfield
Topo: E. Brookfield